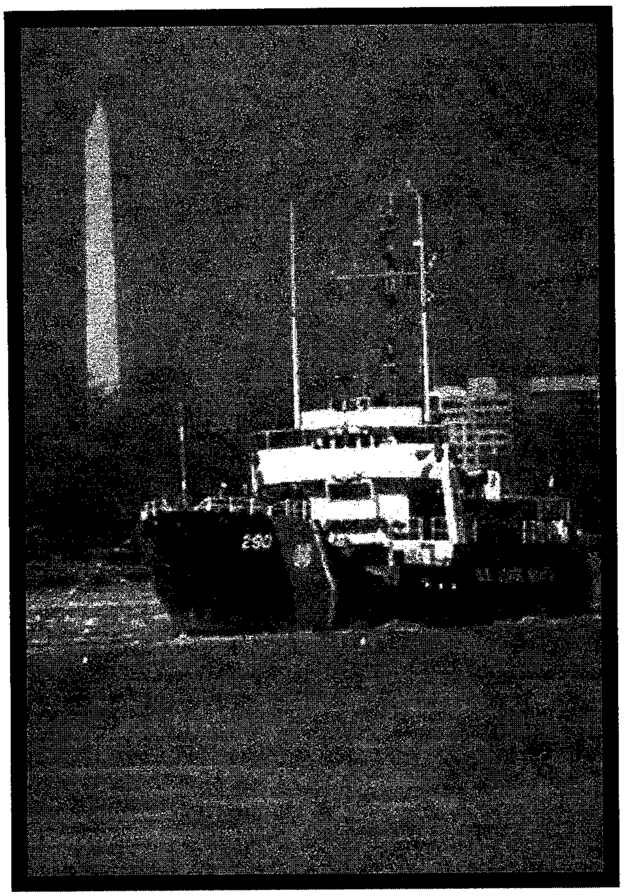
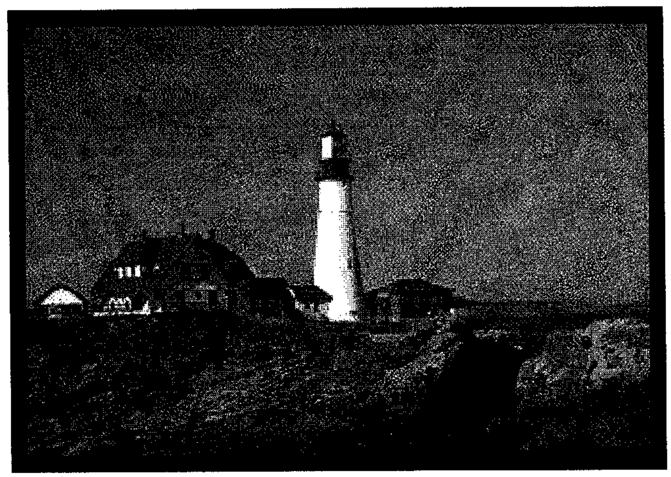
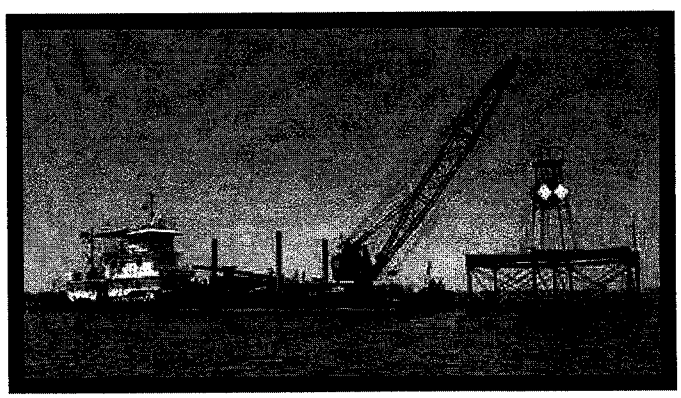
U.S. Department
of Transportation
United States
Coast Guard

AIDS TO NAVIGATION MANUAL
SEAMANSHIP







COMDTINST M16500.21

U.S. Department of Transportation

United States Coast Guard

Commandant
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Staff Symbol: G-OPN-2
Phone: (202) 267-0346

COMDTINST M16500.21
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COMMANDANT INSTRUCTION M16500.21

Subj: AIDS TO NAVIGATION MANUAL - SEAMANSHIP

1. PURPOSE. To replace and update the Aids to Navigation Manual - Seamanship.

2. ACTION. Area and district commanders, commanders of maintenance and logistic commands, unit commanding officers shall ensure that the provisions of this Instruction are complied with.

3. DIRECTIVES AFFECTED. Aids to Navigation Manual - Seamanship (CG-222-2) is canceled.

4. CHANGES. Recommendations for improvements to this Instruction shall be submitted to the National Aids to Navigation School (NATON).

T. J. MEYERS
Director of Operations Policy
Acting

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CHAPTER 1: INTRODUCTION

A. Purpose.

Specialized Aids to Navigation seamanship plays an important part in safe and efficient aids to navigation operations both afloat and ashore. While local conditions will govern which methods of achieving certain operations are best, there are certain basic principles that form a firm background of good seamanship. The purpose of this manual is to explain good seamanship standards in aids to navigation operations. These standards include historical facts, theories and techniques learned over time by skilled mariners. Above all, it is the goal of this manual to provide the safest methods and guidance possible so our personnel will be doing what may be the most dangerous task in the Coast Guard in the safest environment possible.

B. Non-Mandatory Procedures.

Sometimes this manual suggests recommended, but not mandatory, procedures or alternatives. A mandatory procedure or policy will be marked by the use of the words **will** or **shall**. Refer to COMDTINST M16500.7 (series) for information on the Coast Guard's aids to navigation operating and administrative policies. COMDTINST M16500.3 (series) lists specific manuals that tell how to operate and maintain individual types of aids to navigation equipment.

C. Use.

This manual is intended only for the guidance of personnel involved in the operational side of the Coast Guard aids to navigation program. The procedures listed are meant to be guides in the areas of seamanship and planning for Coast Guard personnel who work in Coast Guard aids to navigation operations.

D. Team Coordination.

1. General. A conscious and deliberate use of the team coordination principles throughout this manual is crucial to reducing the probability of human error. Technical skills are important to aids to navigation operations, but alone will not ensure safety. For a mission which is inherently one of the most dangerous in the Coast Guard, safety depends on coordinated teamwork.

2. Briefings. Briefings shall be conducted before and after major events. Along with specifying safety procedures, briefings should clarify expectations, create a climate for learning, and encourage feedback by constructive critique. Briefings and debriefs serve as a means of continuous improvement.

3. Risk Assessment. Risk assessment shall be a part of event planning and risk management shall be a part of team briefings. Risks shall periodically be reassessed as situations change. Individuals often conduct their own risk assessment for a particular

task or operation, but quite often that information is not shared with the team. By discussing risk, personnel will be better aware of potential hazards and how to control them.

4. Error Trapping. Briefings must empower subordinates to monitor circumstances and report situations that differ from planned events, hazardous conditions, and anytime members have doubt. It is extremely important that s system of notification is in place and is known by every team member.

5. Training. The principles summarized here and throughout this manual are safe work practices that the team must routinely employ. Team coordination skills are outlined in training packages distributed to each unit having aids to navigation as its primary mission.

CHAPTER 2: AIDS TO NAVIGATION RIGGING PRACTICES AND SAFETY PROCEDURES

A. Marlinspike Seamanship and Rigging in Aids to Navigation Work.

1. Introduction. This chapter deals with marlinspike seamanship, rigging, safe applications and safety inspections as they apply to aids to navigation work. Elementary information found in the Coast Guardsman's Manual, has not been included. Other general information on rope knotting and splicing and mechanical appliances can be found in Naval Ship's Technical Manuals (NSTM) and other standard texts on seamanship.

B. Safe Working Loads in Weight Handling Equipment.

1. Fiber Rope. The Government specifications on fiber rope require manufacturers to list a minimum breaking strength for their product. These minimum breaking strengths are derived from tests conducted by the manufacturer under Cordage Institute Standard Test Methods. The breaking strengths of fiber ropes vary depending on type of construction and manufacturer. Therefore, the specific manufacturer information **must** be used when calculating the safe working load (SWL) of materials bought outside the federal supply system. Rope in the system meets the minimum specification.

2. Safety Factors. Safe working loads for fiber and wire rope are determined by applying a safety factor to the manufacturer's minimum breaking strength for new rope. This safety factor is applied because the strength of rope decreases with use. Hence a rope will start with a 5 to 1 safety factor. Because of wear the actual safety factor of the rope may only be 2 or 3 to 1 upon retirement of the rope. For all weight handling applications (not involving hoisting or securing personnel) on Aids to Navigation vessels the standard safe working load factor is 5 to 1. For all weight handling applications involving personnel on Aids to Navigation vessels the standard SWL factor is 10 to 1. This 10 to 1 applications does not apply to boat handling equipment. Boat handling equipment has a safe working load based on the normal hoisting weight of the boat and may not meet the 10 to 1 requirement. Therefore, personnel and equipment not included in the normal hoisting weight of the boat shall be loaded after the boat is waterborne and shall be unloaded before the boat is hoisted.

3. Exceeding the Safe Working Load. If a wire or synthetic rope has been used in an application where the 10 to 1 safe working load for personnel handling has been exceeded, the wire or synthetic rope shall not be used to hoist or secure personnel. This does not prevent the use of the rope for other applications, provided the 5 to 1 safety factor has not been exceeded.

4. Safe Working Load Table. The safe working load has to be calculated for all load handling wire, synthetic, and natural fiber ropes. If the information is not available, the calculations in **Table 2-1** can be used to determine a safe working load.

5. Rigging Appendages. All hooks, chain, swivels, links, pins and shackles used to lift

or secure a load aboard any Aids to Navigation vessel must be:

a. Manufactured from heat treated alloy steel.

b. Have a safe working load stamped on the item by the manufacturer, or be marked by the manufacturer so that the safe working load can be readily determined by consulting a manufacturer's table of safe working loads.

c. If the safe working load cannot be determined for any of these items, the item shall not be used and shall be cut in such a way as to prevent it from being used.

6. Tagging. All wire rope and chain slings shall have a metal stamped tag permanently attached by the manufacturer or unit assembling the sling. This tag shall list the safe working load for the sling. **Table 2-2** gives the formula for determining the Safe Working Load for various slings at various angles. Slings without a tag shall not be used for any application on Aids to Navigation vessels until the sling has been proof tested and a tag affixed. All components used on unit constructed slings must have an SWL equal to or smaller than the SWL of the material used in the sling. Only new wire rope, fiber rope, chain and components can be used in sling construction. When interchangeable end fittings are used they shall be tested and tagged in the same manner as slings. Sling tags shall be metal and shall have the size, reach, type sling, SWL at the normal angle of use and an identification number for record purposes. Interchangeable component tags need only have the safe working load and an identification number for record purposes. Unit rigged fiber rope slings do not need metal tags, but must have the safe working loads calculated based on the application and sling angle. However, fiber rope slings must have a rope tape which records the rope type and manufacture year. This tape should be placed so it does not interfere with the normal use of the sling and will not be subject to removal or being defaced by use. These rope tapes are critical since fiber rope replacement is dependent on inspections outlined in the Naval Ship's Technical Manual, Chapter 613 before each use.

7. Blocks. All blocks shall be of the proper size and of the proper type for use with either manila, nylon, wire rope, etc. All blocks shall be stamped with the safe working load of the block as outlined by *Naval Ships' Technical Manual*, Chapter 573. Blocks without a safe working load stamp shall not be used for any application on Aids to Navigation vessels until they have been proof tested. After blocks have been tested they shall be either tagged or stamped with the safe working load. SWL stamps are especially important when you consider that using nylon rope in a block meant for manila rope could result in the rig failing at the block.

8. Synthetic Slings. Synthetic slings are authorized for use on Aids to Navigation vessels. Synthetic slings shall not be fabricated or repaired by the unit. Synthetic slings must have a tag with the safe working load attached by the manufacturer. The tag must have an individual number assigned by the unit for record purposes. Inspection procedures for synthetic slings contained in *Naval Ships' Technical Manual*, Chapter 573 must be followed. Synthetic slings shall not be used to gripe deck loads.

APPROXIMATE SAFE WORKING LOADS OF NEW BRAIDED SYNTHETIC FIBRE ROPES (LBS.) SAFETY FACTOR = 5			
Nominal Rope Diameter (Inches)	Nylon Cover Nylon Core	Nylon Cover Polypropylene Core	Polyester Cover Polypropylene Core
1/4	420	—	360
5/16	640	—	540
3/8	880	680	740
7/16	1,200	1,000	1,060
1/2	1,500	1,480	1,380
9/16	2,100	1,720	—
5/8	2,400	2,100	2,400
3/4	3,500	3,200	2,860
7/8	4,800	4,150	3,800
1	5,700	4,800	5,600
1 1/8	8,000	7,000	—
1 1/4	8,800	8,000	—
1 1/2	12,800	12,400	—
1 5/8	16,000	14,000	—
1 3/4	19,400	18,000	—
2	23,600	20,000	—

Table 2-1 Calculations for determining safe working loads of rope

Rigging Manual, D.E. Dickie, P.ENG. Construction Safety Association of Ontario, Oct. 1975

S.W.L. = The safe working load of a single vertical hitch for the particular size and type of wire or line being used. L = Sling leg length. H = Height from hook to load.	
SLING TYPE	**Safe Working Load for Sling**
Single vertical sling.	S.W.L.
2, 3, and 4 leg bridle slings, and single basket hitch slings with inclined legs.	S.W.L. X $\frac{H}{L}$ X 2
Double basket hitch sling with inclined legs.	S.W.L. X $\frac{H}{L}$ X 4
Single choker hitch sling with a sling angle of 45° or more.*	S.W.L. X .75
Double choker hitch sling with a sling angle of 45° or more.*	S.W.L. X .75 X $\frac{H}{L}$ X 2

***SLING ANGLES OF LESS THAN 45 DEGREES ARE NOT RECOMMENDED FOR CHOKER HITCHES.**

Table 2-2 Formula for determining safe working load at various sling angles for various sling types

9. Auxiliary Weight Handling Equipment Record. Each Aids to Navigation unit shall maintain some type of record which identifies each weight handling sling (other than fiber rope), interchangeable end fitting, snatch block, load binder, pelican hook, tie down chain, and portable rigged block and tackle. This book shall list the date of purchase or construction, safe working load, and date of last weight test, hooks (other than crane and boom power weight handling system hooks) including the date of last throat opening measurement. Some units keep this information in the Hull History, others use a separate record book.

10. Tests and Inspections. All slings, interchangeable end fittings, snatch blocks, steamboat jacks, pelican hooks, tie down chain, rigged portable block and tackle, shackles and shackle pins shall:

    a. Be visually inspected before each use.

    b. Be weight tested at 1.25 times their safe working load annually. Static loads are to be held for 10 minutes and tensiometers are recommended test methods. All equipment components are to be inspected before and after each annual test. However, only items such as interchangeable end fittings need to be tested as a single component, all others shall be tested fully assembled. The results of these tests are to be recorded in the auxiliary weight handling log book.

    c. Throat openings in all hooks are to be checked semi-annually. Boom and Crane power weight handling equipment system hook information is recorded in the Hull History. All other weight handling hook data is recorded in the auxiliary weight handling log book.

    d. Shackles and shackle pins should all be visually inspected annually for evidence of cracks or deformation. However, there is no requirement to weight test shackles and shackle pins or to maintain individual records. For this reason any suspect shackles and shackle pins shall be cut to prevent their use and discarded.

    e. Inspection/rejection/disposition procedures are covered in the applicable sections of this manual and in the *Naval Ships' Technical Manual*.

C. Types and Construction of Fiber Rope.

1. Uses of Rope. Rope is one of the most valuable and constantly used tools available to a seaman. Aside from its standard uses in rigging, tackles, boat falls, lashings, and stoppers, its flexibility and almost universal application enable seamen to use it in a variety of situations.

2. Rope Classification. Modern ropes are classified as fiber, either natural or synthetic, and wire rope. The descriptions herein deal only with types of rope commonly used in aids to navigation work.

3. Common Types of Rope. The most common type of natural fiber rope in use on tenders is manila. Nylon and polypropylene are the most commonly used synthetic rope materials. Line under 1-3/4 inch circumference is known as small stuff. Small cordage is often made from hemp fiber. It is known in its various types as marline, houseline, roundline, spun yarn, seizing stuff and ratline stuff.

4. Rope Construction. A rope consists of fibers, yarns, and strands. Ordinarily, yarns are formed by twisting fibers to the right; strands are formed by twisting yarns to the left; rope is formed by twisting strands to the right. This forms right lay rope. The twists of the yarns and strands run upwards to the right, vice versa for left lay rope. When three, four, or six strands are twisted together, opposite to the twist of the strands, it is known as plain-laid rope. When three or four plain-laid, three stranded ropes are twisted together, the rope is called cable-laid. This rope has somewhat less tensile strength than plain-laid rope of equivalent diameter. but it is superior for certain types of duty, such as towing, where elasticity and resistance to surface wear is required.

D. Size of Fiber Rope.

1. Measurement. Fiber rope is measured by circumference, except for small stuff which is designated by the number of threads it contains, i.e.: 6-thread, 12-thread, 21-thread. Fiber rope is available in sizes from 3/4 to 16 inch circumference. However, 10 or 12 inch rope is the largest used on vessels of this service. The length of rope is expressed in fathoms and is issued in coils of 100 to 200 fathoms.

2. Common Sizes Used on Board Tenders. Commonly sizes and use are: mooring lines, 5 or 6 inches; cross deck lines, 5 or 6 inches; deck lashings, 2 to 6 inches; buoy head (cage) lines, 2 to 4 inches; hoisting tackle hook tripping lines, or tag lines, 12 to 21 thread, straps and slings, 3 to 6 inches.

3. Sizing. Both manila and nylon ropes are used in aids to navigation work. For all tender requirements, only the size capable of handling the weight involved shall be used.

E. Care and Use of Manila Rope.

1. Care of Natural Fiber Rope.

   a. Do not put a heavy strain on a line which has seen continuous service under a moderate strain, nor one which has been close to its breaking point. The safety of rope decreases rapidly with use, depending on the overload.

   b. When passing turns around capstans, winches, gypsy heads, etc., insure the line is wound around them in the same way it is coiled. That is, left to right or clockwise. Passing the line in a counterclockwise manner will force the lay open, weakening or seriously damaging it. When surging a line on a winch, take care that the turns on the gypsy head do not chafe.

   c. When surging line around bitts, take off enough turns so it will surge smoothly. However, be sure to keep enough turns to maintain adequate control. Taut, dry, manila lines should be immediately slacked off when wetted by rain or spray. Manila shrinks about 4 percent in length when wet; this may subject the line to a greater strain.

   d. No line should ever be stored while wet or damp. After use, clean off sand, grit and salt water as soon as possible by washing down with fresh water. Hang it up to dry in a well-ventilated place, away from paint, oil, or any other chemicals. An occasional sunbath will do it a lot of good. Manila stored even under good conditions deteriorates and will lose about 30% of its strength in 2 years due to weathering alone. When stored under humid conditions, deterioration is more rapid.

e. Remove all kinks before putting a strain on a line. A kinked section of a line can be expected to fail at loads of 20 to 30 percent below the designed strength of the line. Remove kinks before manila lines dry. When a line in service has kinked, it may be throughfooted by coiling down against the lay and bringing the lower end up through the center of the coil. If there are many turns in the line, coil small, if few turns, coil large. In instances where both ends are not free, begin with that part of the line at the cleat and coil down counter-clockwise (for right-hand lay rope). Then dip the end down through the coil pulling it out. Capsize the coil and then coil down with the lay.

f. All 3-inch or larger manila rope purchased through the Federal Supply System is fungicidally treated. This results in an unnatural color, gray-green or dark brown. Field application of preservative compound to rope is not recommended since all of these compounds involve a reduction in strength. When factory treated initially, the original specifications are increased to take care of this reduction. If purchasing manila locally, specify the treated rope.

g. Do not use chain slings or chain stoppers on fiber rope. Chain will cut the fiber and kink the rope. Use manila or nylon stoppers only. Avoid short nips and bends through fair leads, chocks etc.

h. Use the proper size block and sheave. The length of the cheek should be three times the circumference of the rope. The diameter of the sheave should be twice the circumference. For example, a block with a 12-inch cheek would be suitable for use with 4-inch rope.

2. Uncoiling. The biggest problem faced when opening a new coil of rope is deciding which side of the coil the bitter end should be drawn through. If properly packaged, the rope will reeve from the center of the coil and lie reasonably free of kinks. The following procedure should remove some of the mystery of proper uncoiling: First, remember that manila must be coiled in a clockwise direction and uncoiled in a counterclockwise direction. Now look into the center of the coil and locate the bitter end. It should be marked at the rope walk with a tag (which frequently becomes lost). Study the direction in which the last few feet of rope are wound and visualize it unwinding. If you were to reach into the center of the coil and pull the bitter-end towards you would it unwind in a counterclockwise direction? If not, turn the coil so it will. This is the key; as the end of the rope is pulled out it must reeve off the coil in a counterclockwise direction motion. (See **Figure 2-1**.)

F. Inspection of Natural Fiber Rope.

1. General. Natural fiber rope should be inspected before each use. Never judge the strength by an overload test. A line which has been loaded near its breaking strength may fail at a much lighter load the very next time it is strained. It is also impractical to

make a determination on the basis of placing samples of a line under a static load test. The samples may test satisfactorily, but there is no assurance that the entire length of line is equal in strength to the samples. The only practical method of determining the overall condition of natural fiber rope is by a careful visual inspection. In any event natural fiber rope shall not be kept in service more than five years. Specific inspection information is found in *Naval Ships' Technical Manual*, Chapter 613. The most important danger signs are listed below.

2. Broken Fibers. Surface abrasion will cause the fibers to break at the top or crown of each strand. The broken ends will then normally be worn off until they appear as the ends of very short vertical fibers in the trenches between the ridges of the strands. This gives a line a smooth appearance. This smooth appearance, with no pronounced ridges and valleys, is a certain way of detecting a badly worn and much weakened line. Broken fibers can also result from overstressing a line. When examining the interior, take care to distinguish broken ends from the free ends of fibers. The recommended method is to compare a used line with new rope which is known to be in good condition.

3. Internal Wear. Frequent flexing of a line will cause abrasion between the individual fibers, which may not be noticeable on the surface. It will form a fine powder between the strands on the inside of the line. Accumulation of fine powder is a sign of a badly worn line. Inspect interior conditions by reverse twisting a section of line.

4. Mildew and Dry Rot in Manila. When examining the interior of manila rope, check for dark moldy-looking spots. Once started, mildew is practically impossible to stop.

5. Softness or Brittleness. An extremely soft, very flexible line is a danger sign. The opposite condition, brittleness, is also dangerous and can be detected by bending over the loose ends of fibers and comparing them to new rope. In addition, bits of brittle, broken fibers may be found between the strands.

G. Types and Construction of Synthetic Fiber Rope.

1. Synthetic Rope Descriptions. New synthetic fibers are being developed to meet constantly changing needs. Technical information is available from manufacturers. Since nylon is the most common synthetic fiber rope aboard Aids to Navigation vessels, the bulk of the following discussion has been tailored to nylon rope. Here is a list of some of these rope types and their characteristics:

Polypropylene (Olefin). Made in either monofilament, multifilament or film form. Strength is approximately 50% of nylon and polyester. Relatively low melt point. A light weight fiber with high positive buoyancy. Not as abrasion-resistant as polyethylene.

Polyethylene (Olefin). About 5% less strength than Polypropylene and 5% heavier. Low melt point, light weight, high buoyancy. Often used in non-critical applications where buoyancy is required.

Kevlar (Aramid). A special DuPont fiber with strength and stretch characteristics comparable to wire. Very high melting point. Poor abrasion resistance.

2. Nylon. Nylon rope **Three-Strand Twisted** - or regular lay - is constructed in the

same manner as manila line, see **Figure 2-2.**

3. Double braided nylon. Double braided (2-in-1) nylon ropes have greater strength than the twisted nylon ropes. They also have the added advantage of being kink resistant. These ropes require little attention during reeving, coiling or capstan operations.

4. Construction of Nylon Rope. Double braid ropes are essentially two hollow braid ropes, one inside the other. The inner core rope is made of large single yarns having a slack limp braid. The cover rope is also made of large single yarns, with a tight braid to compress and hold the core. These ropes have numerous applications ranging from halyards to mooring lines. They vary in size from 3/4 inch to 21 inches in circumference. The core of double braid can carry up to 90% of the load.

5. Strength of Nylon Rope. As a result of numerous laboratory and service tests it has been determined that, size for size, nylon rope is approximately twice as strong as manila. This factor, along with its high working elongation (30 to 40 percent), superior durability, and inherent rot resistance, makes nylon rope very desirable for many applications. Particularly, it is good where reduced bulk and weight are highly advantageous, and where surging or impact loads are involved.

H. Care and Use of Synthetic Fiber Rope.

1. Nylon Rope Stretch. Nylon rope can withstand repeated stretching without serious effect. When under load it thins down but recovers to its normal size when free of tension. The critical point of loading for twisted nylon is 40 percent extension, i.e., a 10-footlength will measure 14 feet. If this point is exceeded, the line is in danger of parting. Twisted nylon rope on parting is stretched about 50% in length. This length is recovered instantaneously with resulting snapback. In view of this, it is imperative that no one stand in the direct line of pull when heavy loads are applied. To ensure that twisted nylon towing hawsers are below the critical working elongation of 40%, attach a 40-inch length of tape to a 30-inch length of the hawser before loading. If the tape should break, the hawser has elongated 33-1/3% and the tow should be eased. To ensure against overloading double braided nylon rope, attach a 40-inch tattletale to two points on the hawser 32 inches apart under approximately 10 lbs. tension. The critical point of loading for double braided nylon rope is reached when it is stretched over 25 percent of its length. Wet nylon hawsers under strain will emit steam-like water vapor. This is normal even under safe working loads.

2. Belaying Nylon. Do not belay wire or spring-lay rope on the same cleat or bitt used for nylon or run it through the same chock. Chafing gear should be used freely where metal edges are encountered. Nylon line under heavy strain may develop glazed areas where it has worked against bitt or chock surfaces. This condition may be caused by removal of paint from metal surfaces or the fusing of nylon fibers. In either case, the effect on the rope strength is negligible. Due to nylon's coefficient of friction being lower than that of manila, it may slip while being eased off the bitts. To avoid injury to personnel, more turns on the cleat or capstan than would be required with manila line are recommended. Do not use a single part of plain laid line for hauling or hoisting any load which is free to rotate.

3. Nylon Rope Stoppers. Use only rat-tailed nylon rope stoppers with nylon line. Plain nylon is safe, but is not easily handled. Manila stoppers are unsafe and chain is not satisfactory, due to the damaging effect. Because of the lower coefficient of friction of nylon, be sure that the stopper is holding before transferring the load. Once it has started to run, nylon is almost impossible to stop.

4. Maintenance.

   a. Do not uncoil new nylon rope by pulling the bitter end up through the eye of the coil. Unreel it like wire rope (See **Figure 2-3**). Should kinks develop due to uncoiling they can be worked out. Never attempt to clear kinks by dragging the rope in the water as this may tend to unbalance the lay and cause irreparable damage to the rope.

   b. Reel stowage is preferred for nylon. The line should be dried before stowage. Do not stow nylon openly in strong sunlight for long periods; if necessary cover the line. In stowage, keep away from heat, strong chemicals, and moisture.

   c. Should nylon lines become slippery due to accumulation of oily or greasy materials, they should be scrubbed with mild soap and fresh water. Isolated spots may be removed by use of light rubbing oils followed with soap and water.

   d. Nylon will, in service, develop a surface fuzz. This fuzz has little effect on the strength of the rope. Broken yarns observed in strands when the rope is opened is a positive indication of loss of strength.

5. Splicing. Three strand nylon can be spliced like manila. Instead of using seizing stuff for whipping the strands and rope ends, tape and then fuse the ends with a hot knife. Nylon lines, because of their smoothness and elastic properties, require at least one more tuck in all splices. Nylon line larger than four inches in circumference should have at least four full tucks before tapering. Three or four tapering tucks are recommended. When trimming leave the ends longer than with manila until the splice is well set. Most manufacturers provide excellent technical manuals for splicing line.

I. Inspection of Synthetic Fiber Rope.

1. General. Synthetic fiber ropes, properly handled and maintained, should remain serviceable far longer than natural fiber rope. No set retirement period for synthetic fiber rope exists. Naval Ship's Technical Manual Chapter 613 contains specific information about synthetic line inspection. **Table 2-3** provides an excellent reference for synthetic line inspection and replacement.

J. Fiber Rope Slings and Tackles.

1. General. Rope slings are important tools in loading and handling material. They are used on board tenders for hoisting cylinders, small unlighted buoys, batteries, general cargo, ship's stores, and other items. Fiber slings may be made of line or flat woven strapping, in a variety of fibers.

2. Sling Types.

   a. Slings come in two types, the single line with an eye splice or thimble in each end,

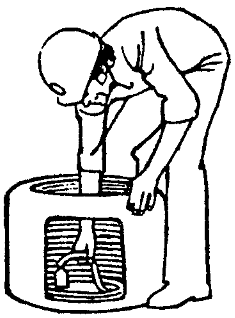

Fig. 2-1 Procedure to Uncoil New Manila
Rigging Manual, D.E. Dickie, P.ENG. Construction Safety Association of Ontario, Oct. 1975.

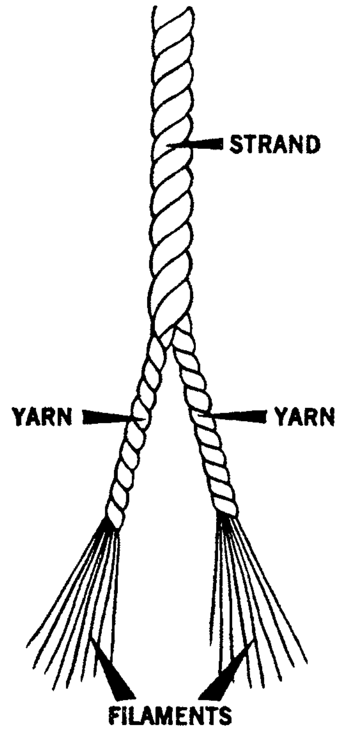

Fig. 2-2 Nylon rope construction

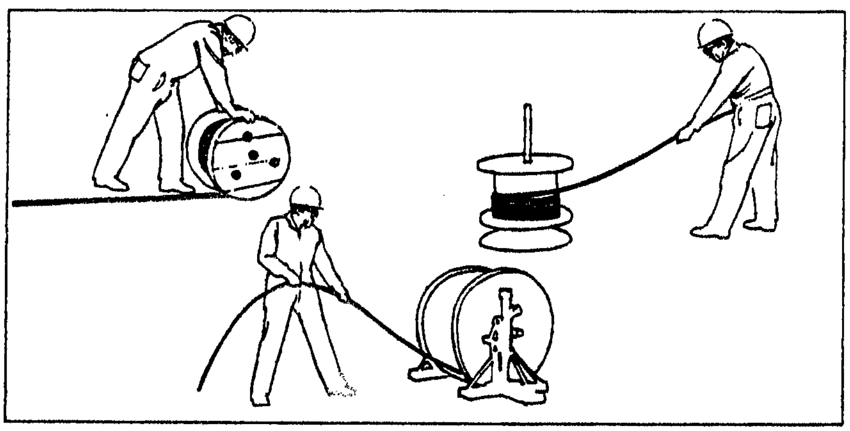

Fig. 2-3 Procedure for unreeling nylon and wire rope
Rigging Manual, D.E. Dickie, P.ENG. Construction Safety Association of Ontario, Oct. 1975

Characteristics	**Resplice** (If localized)	**Replace**
Rope suspected of being shock loaded.		X
Rope that has exceeded 75% of its minimum breaking strength.		X
Bulk of surface yarns or strands reduced by approximately 50% for a linear distance equal to 4 times the rope circumference.	X	X
3 or more adjacent cut yarns in the strands of ropes 4 1/2" circumference.	X	X
4 or more adjacent cut yarns in the strands of ropes 5" circumference and larger.	X	X
Stretchout: Circumference reduced by 5% from circumference when new. (measured under slight tension)	X	X
Cockling.	X	X
Oil and grease.	Wash in mild detergent	
Heavy surface fuzz progressive.	X Remove abrasion	X
Burns of melting visible for a length over 4 times the rope circumference.	X	X
Rust on nylon.	X (Or clean)	X
FOR BRAIDED ROPES		
More than 4 adjacent pulled cover strands which cannot be reincorporated into the cover braid.	X	X
Core visible through cover because of cover damage.	X	X
Core damage (pulled, cut, abraded, melted strands).	X	X
FOR 3-STRAND AND 8-STRAND PLAITED ROPES		
Damage in valley between strands.	X	X
Powdering between adjacent strand contact surfaces.	X	X

Table 2-3 Guidelines for Synthetic Line Inspection

and the endless sling, also known as a strap.

b. The single line sling with the eye splices in each end, or "snorter," can be used by looping it around the load and hanging both ends on the hook. It can also be used by slipping one end through the eye on the opposite end and hoisting by a single part. The first method should never be used with only one sling since there is practically no grip on the load. When used in the second manner with packages of the same size, the wear is always on the same spot even though the ends are continually reversed. Therefore the sling should be discarded due to rapid wear on a very short section. Frequently a hook is spliced in each end, and a bight seized in the middle for hoisting.

c. The endless sling can be used as an open loop by carrying the sling around the load and putting both loops over the hook, or by slipping one loop through the other, thus making a self-binding sling. This type of sling has the advantage of not causing the bight to occur continually in the same spot. Endless slings are made from 2-1/2 to 6-inch line, anywhere from 3 to 6 fathoms long, with the ends joined in a short splice.

d. Except for small general purpose slings, aramid or Dacron is the preferred material for fiber slings. Nylon slings are available in strengths required for handling buoys and sinkers. However the inherent stretch in nylon makes their use hazardous.

3. Use of Slings.

a. Always apply padding to sharp container edges or corners.

b. Keep the angle between the legs of the sling as small as possible to avoid placing extra tension on the sling. **Figure 2-4** shows how rapidly the load on the sling increases as the angle between the legs of the sling decreases.

c. Attempt to reduce the sharpness of the bend of the rope over the hook as much as possible.Watch for cuts and abrasions.

d. Bear in mind that multiplying the number of parts of the sling does not increase the effective strength in proportion. Friction and sharp angles prevent full utilization of all the parts.

e. Splice rather than knot. A well made splice retains up to 90 percent of the strength of the rope, while a knot retains only 50 percent or less. Slings made of flat strapping cannot be spliced, and must be purchased premade and proof tested.

f. Discard any fiber sling on which battery electrolyte may have been spilled. (Polyethylene line is recommended for use around batteries because it is not affected by battery electrolyte).

K. Types and Construction of Wire Rope.

1. General. Although there are various types of wire rope that fit a multitude of requirements, the following is restricted to wire rope used on tenders.

2. Description. Wire rope is a flexible, multiple-wire, precision machine-made rope,

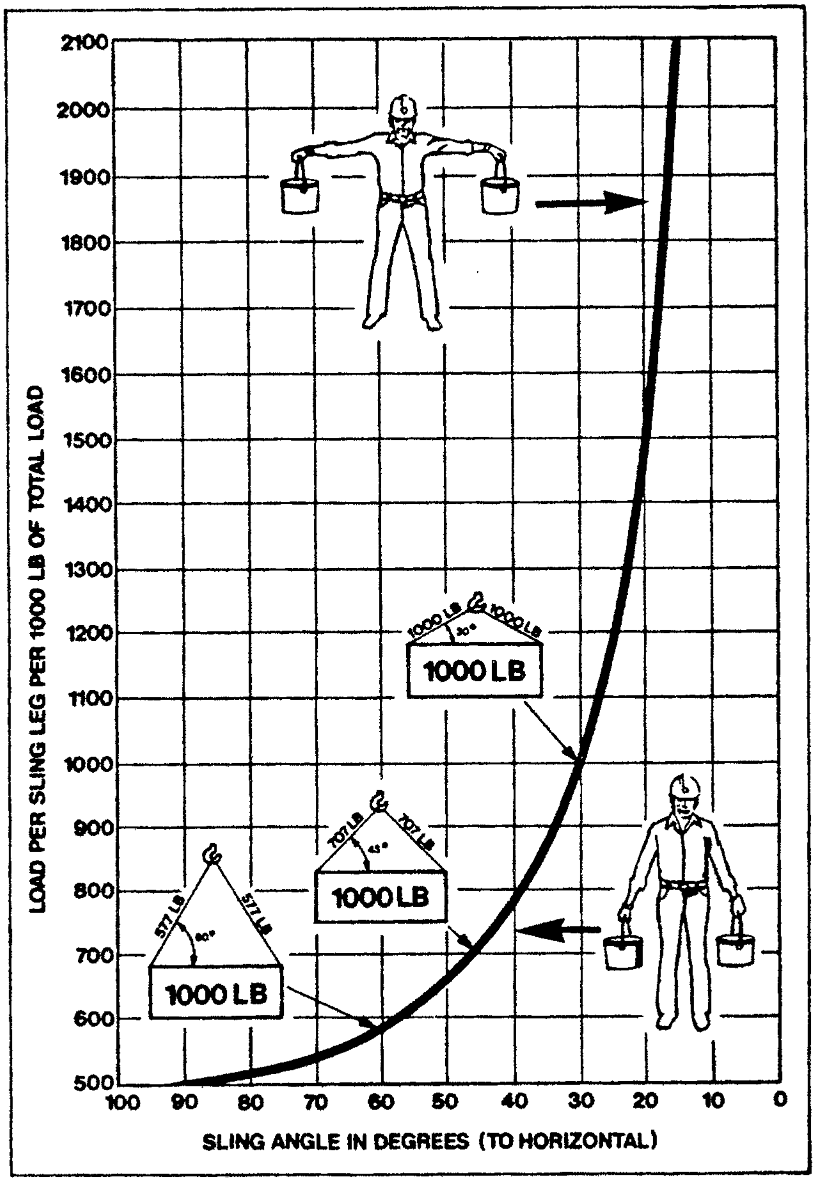

Fig. 2-4 Load increases rapidly as the angle of the sling over the load decreases

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made from high strength cold-drawn steel wires. It is intended for use as a tension member in hoisting, hauling or supporting loads. Flexibility is obtained by the helical formation of many small wires into strands and the subsequent helical formation of such strands (six) around a core to form a rope (See **Figure 2-5**). Before you can use a rope properly, you must understand its construction and properties.

3. Construction. The basic unit of wire rope is the wire, processed from selected grades of steel. After the wires are drawn to size they are helically laid together in a uniform geometric pattern, a strand, with a definite pitch or lay. The strands are in turn again twisted about a central core, or heart, of hemp, independent wire rope, or steel center strand. As a rule, 6 strands are used and the number of individual wires in each strand varies from 6 to 37. The more wires, the more flexible the rope. Thus a 6 x 37 wire rope consists of 6 strands of 37 wires each or a total of 222 wires. All of these must be able to bend and move with respect to one another if the rope is to have the flexibility necessary for normal operations.

4. Cores.

   a. The core is the foundation of a wire rope. Its primary function is to support the wire strands, maintaining them in their correct relative positions during the operational life of the rope. When subjected to a load, the strands, because of their helical shape, imbed themselves into the core. If the core is removed, broken or weakened the strands may be able to deform, causing severe damage to the wire rope. This also causes a significant reduction in breaking strength. The core also transfers lateral pressures from contact with sheaves or drums to the strands not making contact.

   b. Fiber cores are simply small diameter fiber ropes. Most fiber cores (FC) are made of polypropylene. A fiber core provides maximum flexibility and elasticity to the wire rope structure. However, fiber cores are susceptible to crushing due to their relative softness.

   c. Independent wire rope cores (IWRC) are usually small six-stranded ropes with a strand as a core. IWRCs resist crushing since they are a steel rope. IWRCs also make a rope less flexible, but add about 7 1/2 percent to the break strength of the rope, depending on the termination.

5. Wires. The wires in a rope are round in cross-section. Round wires can slide and rotate against each other as the rope is loaded or bent. Other types of wires are made, but they are used in very special situations. The grade of steel used in making the wires has a significant effect on the breaking strength. To a lesser degree the grade effects flexibility and abrasion resistance. The following grades of steel are used in wire manufacturing:

   a. Plow steel (PS): lowest break strength, lowest resistance to wear, highest fatigue life.

   b. Improved plow steel (IPS): good combination of qualities; medium break strength, medium resistance to wear, medium fatigue life and less flexibility.

c. Extra improved plow steel (XIP): higher break strength, more resistance to wear, lower fatigue life and less flexibility.

d. Extra extra improved plow steel (XXIP): highest break strength, most wear resistance and lowest fatigue life. A wire rope of this grade must have sheave and drum diameters favorable to its use.

6. Strands. The strands, made of the wires, are helically laid around the core. Unless otherwise specified in the vessels plans, all ATON vessels use six-stranded wire with IWRC rope. Due to improvements in wire technology, fiber core wire is becoming obsolete. Newer vessels will normally use special construction wires or 6 strand IWRC wires. Changes to the wire type specified in the vessel's plans must be approved by the Commandant.

7. Pre-Formed Wire Rope. Pre-Formed wire rope is made with pre-formed strands (i.e., each strand and the wires in it have the shape they assume in the finished rope). Pre-formed ropes have many advantages over regular wire rope. They withstand a greater number of bends over a sheave, have a greater flexibility, resist kinking, permit better attachment sockets or feige fittings, and are easier to wind smoothly and evenly on drums. When worn they are safer to handle, as the broken wires will not stick out. All Aids to Navigation vessels shall use pre-formed wire rope.

8. Lays.

a. The direction of twist of the strands in the rope determines if the rope will be right or left lay. The lay of a rope has three different meanings. The lay could be the direction of twist of the wires in a rope, the direction of twist of the strands in a rope or a length along a rope. When looking at a wire rope (See **Figure 2-6**), if the wires appear to run along the length of the rope it is known as regular lay. If the wires look as if they are running across the rope it is known as lang lay. All Coast Guard ropes are regular lay.

b. Descriptions of the different lays follow.

(1) Right-regular lay: The individual wires of the strand are laid up to the left and the strands are laid up to the right. Regular lay ropes are less likely to be kinked, and give additional resistance to crushing, distortion and rotation.

(2) Right-lang Lay: Both the wires of the strands and the strands are laid up to the right. Lang lay rope gives increased wearing surface for certain types of service resulting in longer life for the rope. Lang lay rope offers greater flexibility but has a tendency to crush and untwist. It should not be used with a swivel or in a single part hoist.

(3) Left-regular lay: This lay is the opposite of Right-Regular Lay above.

(4) Left-lang lay: This lay is the opposite of Right-Lang Lay above.

(5) Reverse lay: The strands are laid up to the right and the individual wires of the strands are laid up to the right and left alternately. Reverse lay ropes

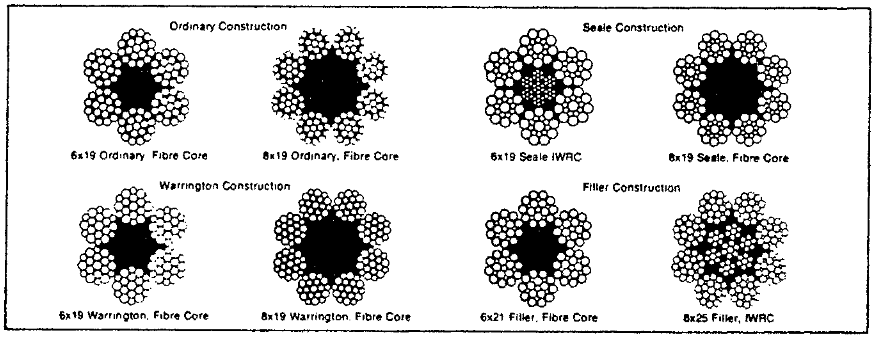

Fig. 2-5 The three basic components of a typical wire rope.

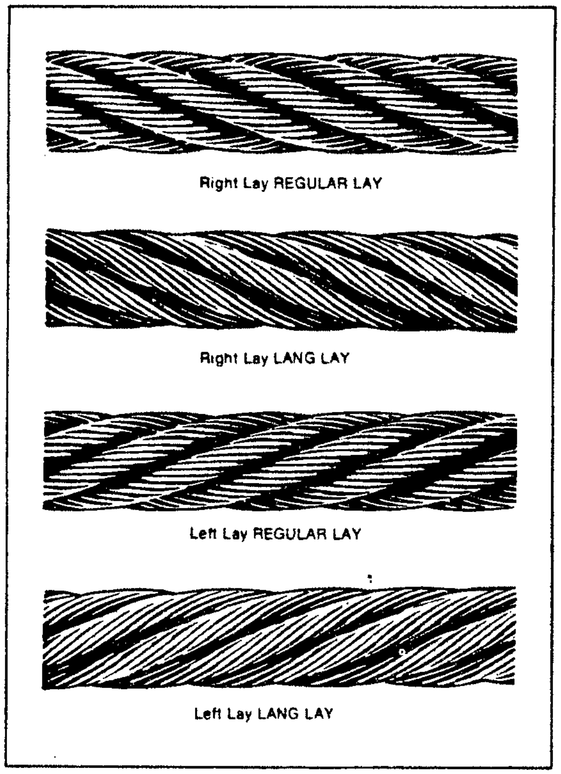

Fig. 2-6 Rope lays

Rigging Manual, D.E. Dickie, P.ENG. Construction Safety Associaiton of Ontario, Oct. 1975 have limited use. They resist distortion and prevent clamp slippage, but sacrifice other advantages.

(6) Special construction: A number of developments in wire rope construction have produced multiple core non-rotating wires and other special purpose constructions. Their advantages and weaknesses vary. Such ropes shall only be used when specified in the vessel's plans.

c. Right and left lay do not affect performance, but are required based on the lead from the drum and from the termination point on the drum. This will be covered later.

9. Lay Length. A rope lay length, an important dimension in inspection, is the distance it takes one strand to go completely around the rope (See **Figure 2-7**). This is easily determined, if the number of strands are known. Start at one strand and count the strands down the rope until the number equals the number of strands. The last strand will be the same one as the first. The distance between the first and last is the lay length

10. Diameter. The diameter of a wire rope is the distance between the crowns of two opposite strands (See **Figure 2-8**). This is easily measured by rotating a caliper around the rope so the highest points are measured. Ropes are referred to by their nominal diameter. American made wire rope will be delivered about 5 percent oversized.

11. Designations. In specifying a wire rope, a set of abbreviations are used to designate the type of rope wanted. The following are standard examples of abbreviations:

Strands/Wires	Core		Material		Lay	
6x37	**FC**	Fiber core	**PS**	Plow steel	**RRL**	Right regular lay
Number of strands=6 Wires per strand = 37	**IWRC**	Independent wire rope core	**IPS**	Improved plow steel	**RLL**	Right lang lay
	Formed		**XIP**	Extra improved plow steel	**LRL**	Left regular lay
	PRF	Preformed	XXIP	Extra extra improved plow steel	LLL	Left lang lay

When ordering wire rope, give all five designations to insure receiving the proper rope. For example, you would order a wire rope of following specification: 6x37, IWRC, PRF, XIP, RRL.

12. Crushing and Flexibility. The number of wires and the type of core have a significant

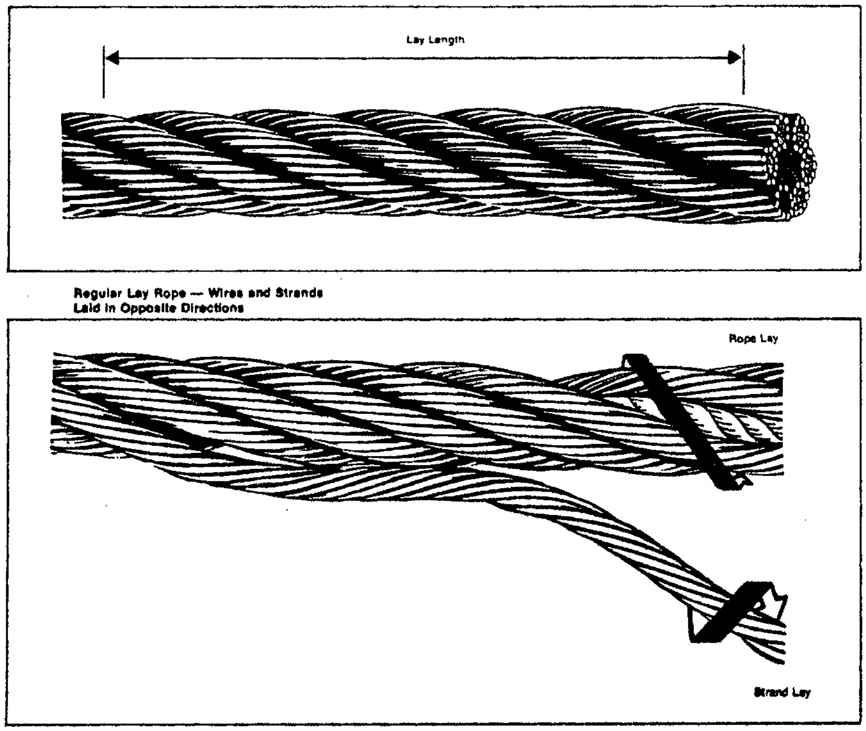

Fig. 2-7 Length of rope lay

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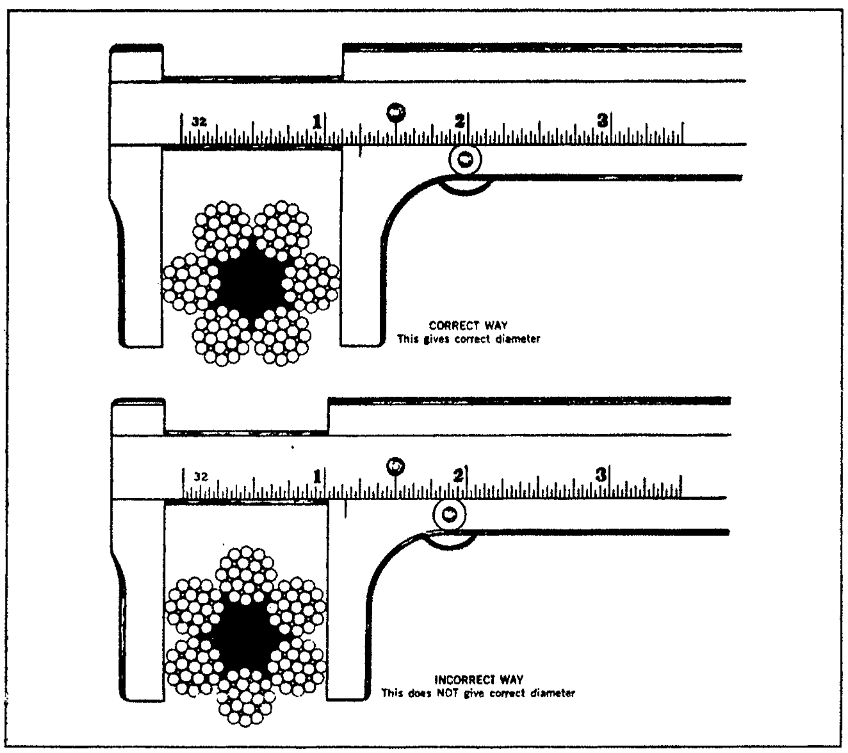

Fig. 2-8 Measuring wire rope diameter

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effect on a rope's flexibility. Flexibility is important in multiple part reeving and situations where only small diameter sheaves can be used. Obviously, the more wires and the softer the core the more flexible the rope. For example, a 6x37 rope is 40 percent more flexible than 6x19 rope of the same size, grade and core type. The opposite is true of crush resistance. The fewer wires and the harder the core, the more crush resistant. For example, a 6x19 rope is 30 percent more crush resistant than a 6x37 rope of the same size, grade and core type.

13. D to d Ratio (D/d).

    a. The sharpness of bend experienced by a wire rope impacts the rope's strength and life. The sharpness is defined as the "D to d ratio" (D/d). **Table 2-4** shows the reduction in the efficiency 9 (percent of break strength) of a wire rope based on the sharpness of the bend.

    b. Compute "D to d" ratio by dividing the sheave's tread diameter ("D") by the wire rope's nominal diameter ("d"). As an example, a 7/8 inch wire rope going over an 18 inch sheave will have a D/d ratio of: 18 divided by 7/8 = 20.6. Observe from **Table 2-4**, this rope's actual break strength is 92.5 percent of its advertised strength. If the sheave was only 5 inches in diameter, the D/d ratio would be 5.7. The rope over this sheave would be able to handle 75% only of its advertised strength. Most rigs are designed with a minimum D/d ratio of 16. Obviously, the sheaves on the boom cannot be increased in size; they would no longer fit. However, the D/d ratio is as important in the sizing of load and snatch blocks.

    c. The D/d ratio effect is not additive. If a wire is going through a number of sheaves, the smallest one determines break strength.

14. Fleet Angle.

    a. The winding on a drum is closely related to the D/d ratio, speed of rotation, load on the rope and the fleet angle. Of all these factors, the one that exerts perhaps the greatest influence on winding characteristics is the fleet angle. The fleet angle on a boom (whip, main, topping and vang) has already been determined during the construction of the system. The fleet angle of wire rope crossdecks is dependent on the position of the system's snatch block.

    b. The fleet angle is the maximum angle the wire rope will travel between the sheave and the drum (See **Figure 2-9**.) For optimum efficiency the angle should not exceed 1 1/2 degrees. Larger fleet angles cause excessive sheave wear and grinding of the rope, turn against turn, on the drum. Excessively large angles will cause the rope to wind open on the drum and at the flange, and the rope will jump or skip several turns when rising from one layer to the next.

L. Care and Use of Wire Rope, Wire Rope Fittings and Appendages.

1. Improved plow steel, pre-formed regular lay, right hand helix, 6x19 to 6x37 wire rope is used in rigging tenders for aids to navigation work. Standard ship blueprints should be consulted for determining the proper size and type of wire rope for standing or running rigging. Deviation from these blueprints is not authorized without approval by

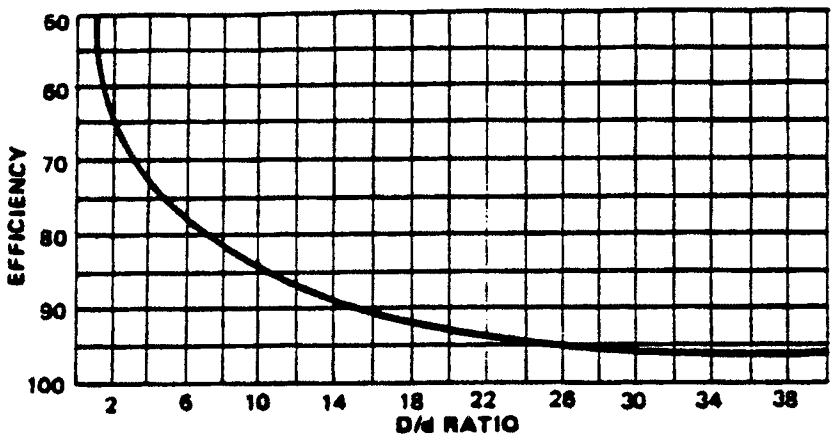

Table 2-4 Efficiencies of wire rope bent around stationary
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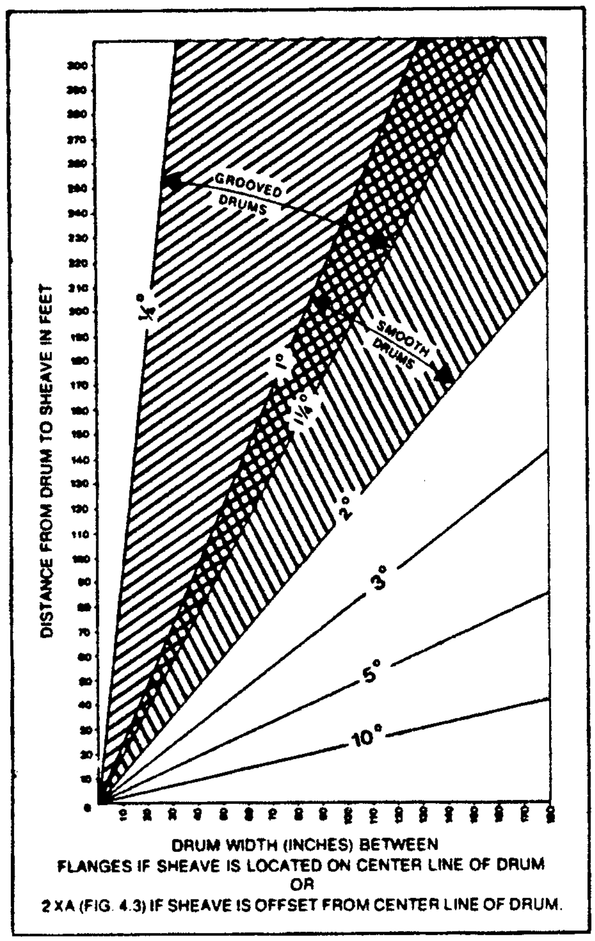

Fig. 2-9 Fleet angle determination
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the Commandant. For other uses where prints or allowance lists do not specify the type to be used, the Fleet Oriented Consolidated Stock List, Group 40, should be consulted to determine the proper type of rope.

2. Additional Sources. The *Naval Ships' Technical Manual*, Chapter 613 gives more detailed information on the care and handling of wire rope. It should be consulted for questions not covered in this section.

3. Break Strengths and Safety Factors.

   a. The breaking strength of a wire rope is set by the manufacturer and is the load that will part the rope when new. **Table 2-5** shows the minimum breaking strengths for commonly used wire ropes. More complete information can be found in the Fleet Oriented Consolidated Stock List, Group 40. All ropes within a given classification, with the same diameter and grade of steel, have the same breaking strength.

   b. To find the safe working load of wire rope, divide the breaking strain by a safety factor chosen for the particular conditions of use. For example, rope used in ordinary hoisting service shall have a safety factor of five. Rope which is to be used to support personnel shall have a safety factor of ten.

4. Care of Wire Rope. Wire rope must be properly lubricated to insure long life and safety. The internal parts of the wire move whenever the rope passes over a sheave or winds on a drum. Each wire rotates around its axis, and all wires minutely slide by each other. Internal wear can be minimized only by lubrication. Chain lubricant, Military specification MIL-G-18458 (ships) type II shall be used when available. If not available, use Lubra-plate or a good grade of engine oil. It must be free from acids and corrosive substances and be thin enough to remain as a coating on the outer surfaces. Wire rope is not necessarily lubricated when the outside appears greasy. Care must be taken to insure the lubricant penetrates into the core of the rope. The preferred and recommended method of lubricating wire rope is to use a mechanical lubricating device such as a Dynalube. (See **Figure 2-10**.)

Improved Plow Steel, Regular Lay, Preformed			
Diameter (inches)	6 X 19 IWRC	6 X 25 Fiber Core Uncoated	6 X 37 Fiber Core Uncoated
3/8	12,793	—	11,540
1/2	22,400	21,400	20,400
5/8	34,900	33,400	31,600
3/4	49,900	47,600	45,200
7/8	67,500	64,400	61,200
1	87,600	83,600	79,600
1 1/8	110,000	105,200	100,200
1 1/4	—	129,200	123,000
1 1/2	—	184,000	175,800
2	—	320,000	308,000

Table 2-5 Minimum breaking strengths for wire rope in pounds
Divide by five for safe working load on new wire rope

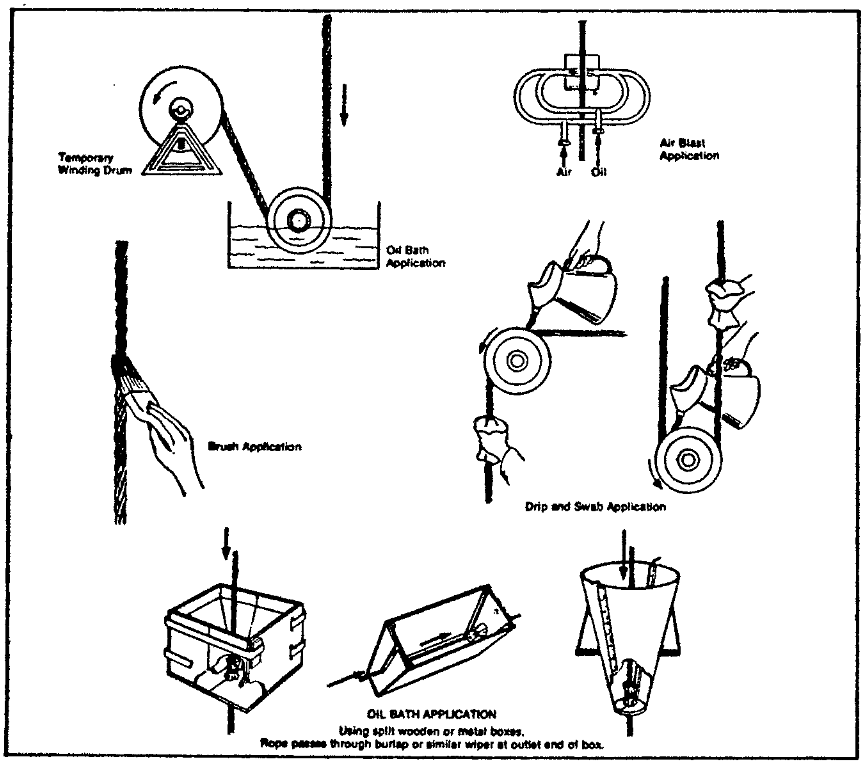

Fig. 2-10 Methods of lubricating wire rope

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5. Installation.

a. When removing wire rope from a shipping reel, the reel must be allowed to rotate as the rope is hauled off. If the reel is restrained, kinks will develop and ruin the rope. When spooling a rope onto a drum, never allow it to go through a reverse bend, i.e., never go from the top of the reel to the bottom of the drum. Unspool from the top of the reel to the top of the drum or from the bottom of the reel to the bottom of the drum. (See **Figure 2-11**.) A reverse bend will injure the rope.

b. Wire rope which is in a coil should be stood on the edge of the coil and rolled like a wheel. When hand coiling wire rope, coil it in the direction that will take the twist out of the rope. Right-lay rope will coil in a clockwise direction.

c. The length of rope wound on a reel or drum can be determined from the following:

Measure the depth of material (h) wound on the reel. Add this figure to the diameter (s) of the drum (hub). Multiply this sum by the depth (h), then multiply the product by the inside length (L) of the drum. Then multiply by a constant (K) for the respective size of rope. The result (X) will be the length of rope on the reel. All of the measurements are in inches and the length of the rope will be in feet. (See **Figure 2-12**.)

d. When installing new rope, all wraps in the first layer should be tight and straight. Successive wraps should be tapped tightly together with a soft object (wooden mallet). This will produce a uniform and closely wound first layer, which in turn, will produce uniformity of successive layers. A loose first layer will allow kinking, crushing and overwinding of subsequent layers.

e. Some drums allow for anchoring on either the right or left side. The direction of the lay of the rope determines which anchoring point to use. Each time a drum is rigged the correct lay/anchoring point should be checked. The procedure for determining the anchor point is as follows:

(1) Determine if the rope will be overwound or underwound. Will it come off the top or bottom of the drum?

(2) Imagine being behind the drum.

(3) For right lay rope, make a fist with your right hand to simulate the drum, and extend your forefinger to simulate the rope. If the rope is overwound the back of the hand must be up so the forefinger "comes off the top of the drum" just like the rope. If the rope is underwound the palm would be up so the forefinger "comes off the bottom of the drum" like the rope.

(4) With your hand in the correct position extend your thumb. The thumb points to the side where the anchoring must be done.

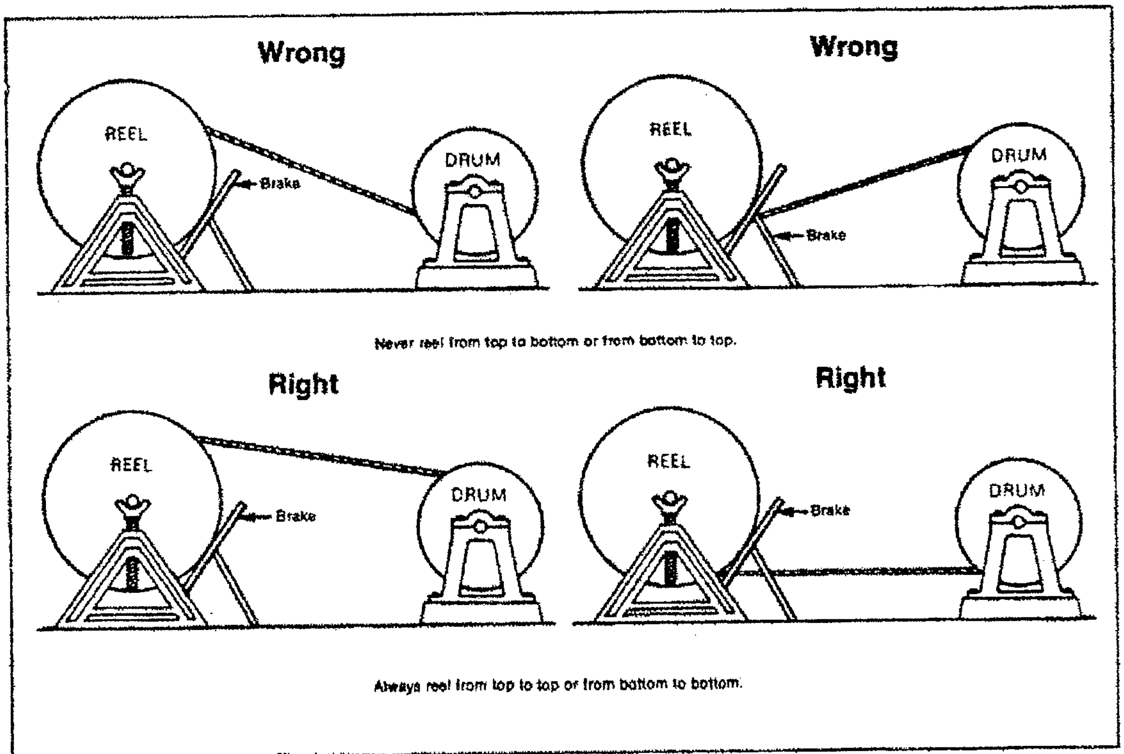

Fig. 2-11 Methods of winging rope from reel to drum, or reel to reel

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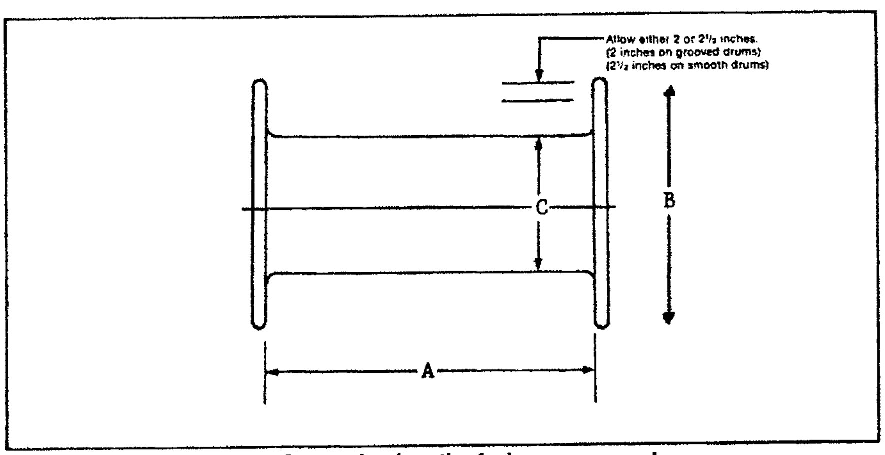

Fig. 2-12 Computing length of wire rope on reel

(5) Left lay rope should be treated in an opposite manner. (See **Figure 2-13** for the "Thumb Rule".)

f. When the first layer of wire rope is wound on a smooth drum in the wrong direction, the coils tend to spread apart or roll in the opposite direction of the lay. Coils of the second layer wedge themselves between the open coils, causing non-uniform winding, which may result in damaging the rope from crushing and abrasion. There is also a tendency for the remaining coils on the drum, when the rope is out and the load slacked off and then applied again, to cross other coils. The result is crushing of the rope at the point of the crossover.

6. Wire rope is a machine. Under service a wire rope loads up along its entire length. Hence wear occurs both internally and externally. Therefore, wire rope shall never be end for ended in an attempt to distribute wear. If one broken wire is found at a fitting end ten feet of wire rope may be removed and a new fitting attached instead of complete rope replacement. However, a weight handling test must be performed before placing the rig back into service.

7. Inspection/Replacement. All wire rope rigging shall be visually inspected quarterly for wear, and for proper lubrication. Determine whether deterioration has resulted in appreciable loss of original strength and constitutes a safety hazard. *Naval Ships' Technical Manual*, Chapter 613 contains detailed inspection procedures and is the recommended source for wire rope replacement information. However, one or more of the following conditions shall be sufficient reason for questioning rope safety and requiring its replacement:

a. The nominal rope diameter is reduced by more than the amount shown in **Table 2-6** for the applicable size rope. In running ropes, six broken wires in one rope lay length or three broken wires in one strand in one rope lay.

b. One broken wire within one rope lay length of a fitting. (Cut off from six to eight feet of rope below the socket, reinstall fitting, retest.)

c. Evidence of pitting due to corrosion.

d. Evidence of heat damage.

e. Kinking, crushing, or distortion of any kind that may affect rope service.

f. Wire ropes in standing rigging must be replaced if there are three broken wires in one rope lay.

8. Cutting.

a. Care must be taken to prevent spreading of the strands when cutting, especially if the rope is to be attached to fittings with small openings. Hydraulic or mechanical rope cutters, or guillotines, are recommended for cutting wire rope. Torches shall never be used to cut wire rope.

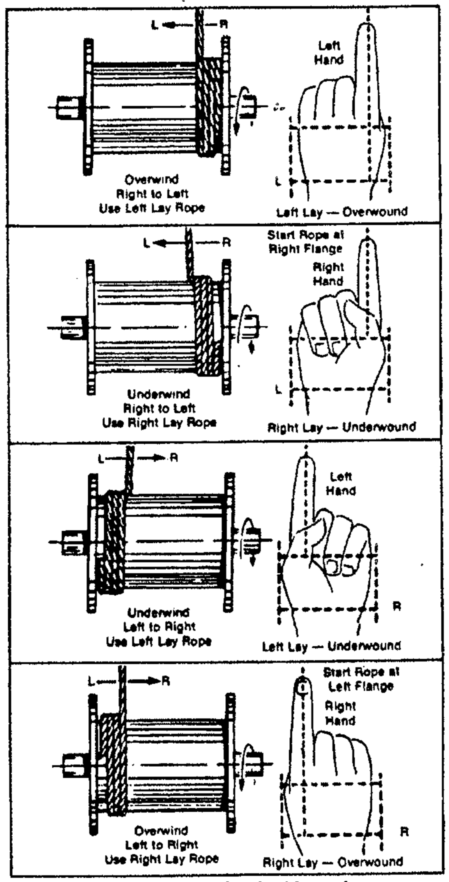

Fig. 2-13 Proper method of locating rope anchorage point on a drum

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Rope Diameter (inches)	Maximum Allowable Nominal Diameter Reduction
<3/8	1/64
3/8 - 1/2	1/32
9/16 - 3/4	3/64
13/16 - 1 1/8	1/16

Table 2-6 Maximum allowable wire rope diameter reductions

b. Seizings should be placed on either side of the spot to be cut. If non-preformed wire rope is not seized before cutting, the ends will unlay violently. Directions on how to make wire rope seizing follows:

(1) To make a seizing on wire rope, wind annealed iron seizing wire onto the rope by hand, keeping the coils tight, with considerable tension on the wire (See **Figure 2-14**).

(2) Twist the ends of the wire together counter-clockwise, so the twisted portion of the wires is near the middle of the seizing.

(3) Do not try to tighten the seizing by twisting; tighten the seizing by prying the twist away from the axis of the rope.

(4) Tighten the twist again.

(5) Repeat (3) and (4) as often as necessary to make the seizing tight. When done, cut off the ends of the wires and pound the twist close against the rope.

9. Wire Rope Splices. Good descriptions of short, long and eye splices can be found in Knights Modern Seamanship. Running rigging on Aids to Navigation vessels shall be single piece from termination to termination and shall be free of splices.

10. Wire Clips.

a. The number of wire rope clips which should be used to develop maximum strength is listed in **Table 2-7**.

b. When attaching wire rope clips, be sure that the U-bolt rests on the short or bitter end of the rope and that flat base rests on the tension part (See **Figure 2-15**). Otherwise, the rope will be injured by putting a crimp into the tension side. Never stagger the wire rope clips. Clips should be spaced a distance apart equal to 6 times the diameter of the wire. After attaching a clip on a wire rope, tighten all nuts again after the rope is under tension. Tighten them again after the rope has been in operation for a few hours. When inspecting clip fastenings, it is important to examine the rope at the clip farthest from the bight. Rope vibrations or whipping are dampened here, and fatigue breaks develop. Fatigue damage will be less pronounced with pre-formed rope.

c. Wire rope clips are a temporary rigging solution. They may be used in aid construction, and to form a temporary eye for a mooring cable or other general purpose rigging. Do not use wire rope clips for slings or weight handling rigs. The only exception to this is their use as a preventer on the bitter end (only) of a wedge socket used aboard a construction tender. Wedge sockets will be described later in this chapter.

11. Wire Rope Sockets.

a. End fittings are of the greatest importance to safety. It is important to understand that most fittings, even when properly installed, cannot withstand the full break strength of the wire rope. An exception to this is a commercially available epoxy

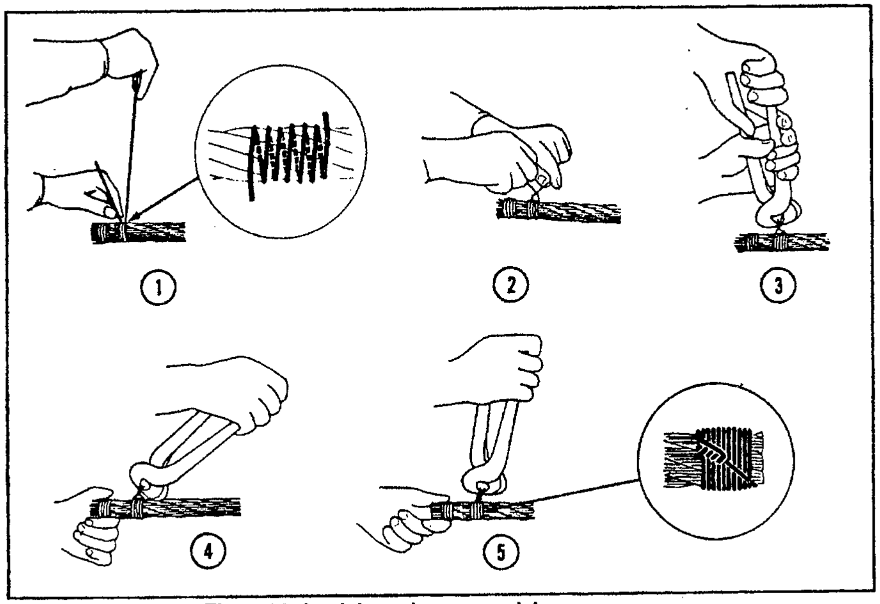

Fig. 2-14 Applying wire rope seizing

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Size of Clips (Corresponding to Rope Diameter in inches)	Number of Clips to Develop Max. Strength
½	2
5/8	3
3/4	3
7/8	4
1	4
1 1/8	5
1 ¼	5
1 1/2	6

Table 2-7 Wire rope clips required for various diameter rope.

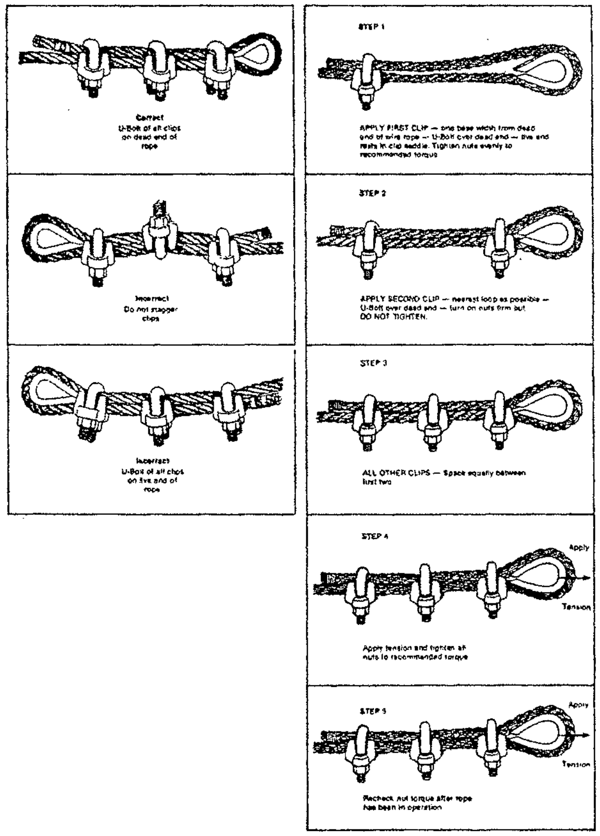

Fig. 2-15 Attaching wire rope clip

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resin system, similar to a poured zinc fitting, which is rated at 100% when used in accordance with manufacturer's instructions. This type of fitting is authorized for overhead lifting on all ATON vessels. It is preferred for use with any wire rope having a wire core, and must be used if the vessel was initially provided with this type of fitting. Forged fittings of weldless construction are the only type recommended for overhead lifting. Most AtoN units use feige fittings.

b. Feige fittings can withstand approximately 85 percent of the breaking strength of improved plow steel wire rope. Made of three parts, feige fittings include a sleeve which slips over the end of the wire rope, a plug which is inserted to separate and hold the strands of the rope in the sleeve, and a covering socket. The Feige fitting works on a wedge principle. The plug is tapered as is the inside of the sleeve. Due to the friction between the strands and the plug, the plug is drawn deeper into the sleeve as a load is placed on the rope. The tapers of the plug and sleeve combine to wedge the strands between them, thus holding the rope.

c. Fiber core wire ropes require the use of solid plugs. IWRC wire ropes require the use of split plugs.

d. The recommended installation procedures for feige fittings (Refer to **Table 2-8 and Figure 2-16**) are:

(1) Place assembly blocks on the rope, then place the blocks in a vise.

(2) Position end of rope to dimension "A" as shown on **Table 2-8** for the size rope being assembled. Tighten vise firmly.

(3) For fiber core rope only: unlay two strands of the rope (<u>do not unlay any of the wires in the strands)</u> and cut out the fiber core as close to the assembly blocks as possible. Twist the two strands back to original position.

(4) Twist the untreaded end of sleeve over the end of the rope. Twist in the direction of lay. Twist until dimension "B" is attained.

(5) Unlay one of the strands. On right lay rope unlay the remaining five strands in a counterclockwise manner. When done correctly, the six outer strands form a symmetrical basket. Do not attempt to straighten the spiral lay of the six strands. For fiber core rope only: Place the plug in the center of the six strands. Drive the plug downward with a hammer while making certain that each of the strands is positioned properly in the plug flutes. The symmetrical basket shape must be retained while the plug is being seated. Drive the plug to a solid seat.

(6) For IWRC rope only: Do not unlay the core. Insert both halves of the plug around the center core. Drive the plug downward with a hammer while making certain that each of the strands is positioned properly in the flutes of the plug. The symmetrical basket shape must be retained while the plug is being seated. Drive the plug to a solid seat.

Wire Rope Size	A	B
3/8"	1/3"	1 1/8"
7/16"	5/8"	1 5/16"
1/2"	4 1/8"	1 1/2"
9/16"	4 3/4"	1 5/8"
5/8"	4 3/4"	1 5/8"
3/4"	5 1/2"	1 7/8"
7/8"	6 1/2"	2 1/4"

Table 2-8 Feige socket installation dimensions

Rigging Manual, D.E. Dickie, PIENG. Construction Safety Association of Ontario, Oct. 1975

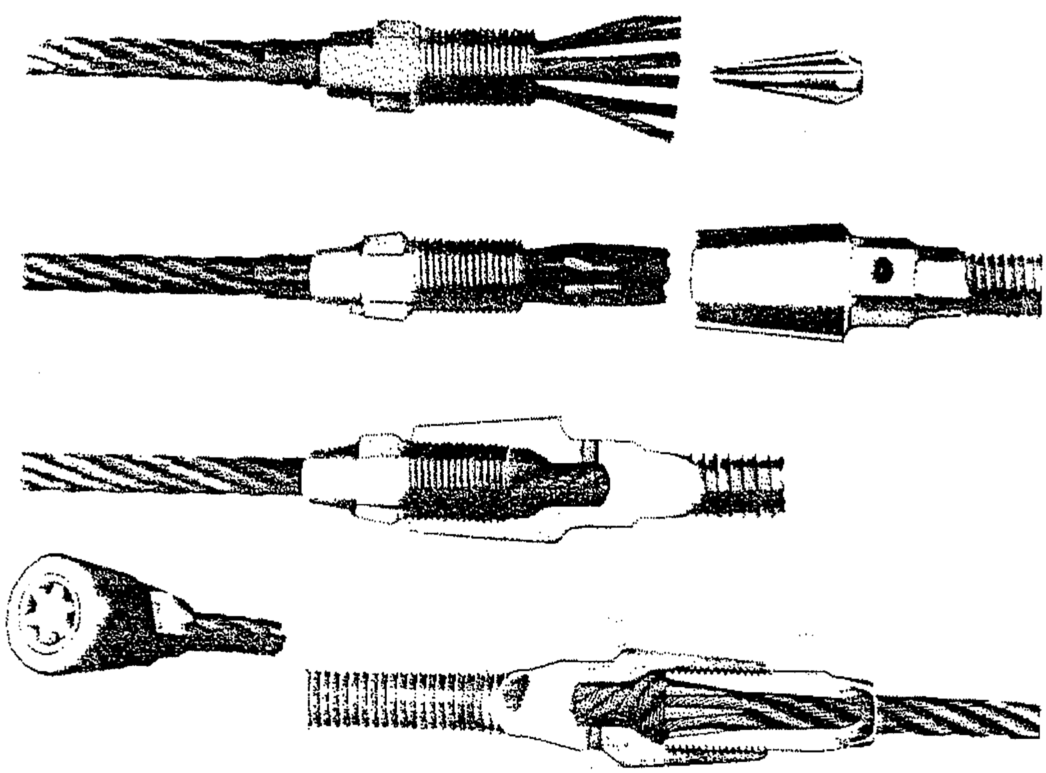


Figure 2-16 Feige wire rope socket

(7) Remove assembly from vise, remove assembly blocks and clamp the hex of the sleeve in the vise.

(8) With a piece of tubing (Inner Diameter of tubing should be 1/32" to 1/16" larger than Outer Diameter of each strand of rope) bend each of the six outer strands in toward the center of the plug.

(9) Place socket part over ends of strands, twist on in the direction of the lay of the rope. Engage threads of sleeve and tighten socket securely on sleeve.

(1) Review work (if assembled correctly, the end of the rope will be visible in the inspection holes. <u>No more than four threads should be visible on the sleeve after tightening</u>.)

(2) Apply proof load to the assembly (the plug will seat further in the sleeve and the rope will not be visible in the inspection hole).

(3) Paint end fitting and a section of the wire with white paint so it will be readily apparent if the fitting slips.

e. Wedge Sockets. Wedge sockets are the simplest fittings because of their ease and speed of applying and detaching. Wedge fittings are authorized only for overhead lifting aboard construction tenders. A wedge socket can withstand only approximately 75 percent of the break strength of the rope. The installation of the wedge socket is fairly obvious, but a few procedures must be observed (See **Figure 2-17**):

(1) Make certain that the live end of the rope lines up with the hook.

(2) Extend the dead end of the rope 6 to 9 times the rope diameter.

(3) Place a wire rope clip around the dead end by clamping a short, extra piece to the tail. These precautions are necessary to ensure full performance of the fitting. Periodically checking the length of the tail to determine if the rope is being pulled through. The wire rope clip keeps the rope from flattening, which would permit easier pull-out and failure.

f. Other terminals for wire rope may be used, but are more difficult to install. Poured fittings and swagged (pressed) fittings can withstand nearly 100 percent of the break strength of the rope. Swagged fittings are nearly always applied to wire rope slings.

12. <u>Rigging Swivels</u>. All swivels must be properly sized for the rig in which they are placed. Swivels are necessary to limit the rotation of the load. The wire rope, when taking a strain, will rotate to equalize the load in the strands and wires. Swivels should rotate freely and easily. Semiannually, rotate the swivel to insure that it does turn easily. If the swivel does not turn easily, disassemble and inspect it for wear on the bearings and lack of grease. The swivel ends should also be inspected for wear. Like hooks, if swivels have nicks and gouges they should be ground out and faired into the body. If the wear or the grinding results in a 10 percent reduction or more in the cross

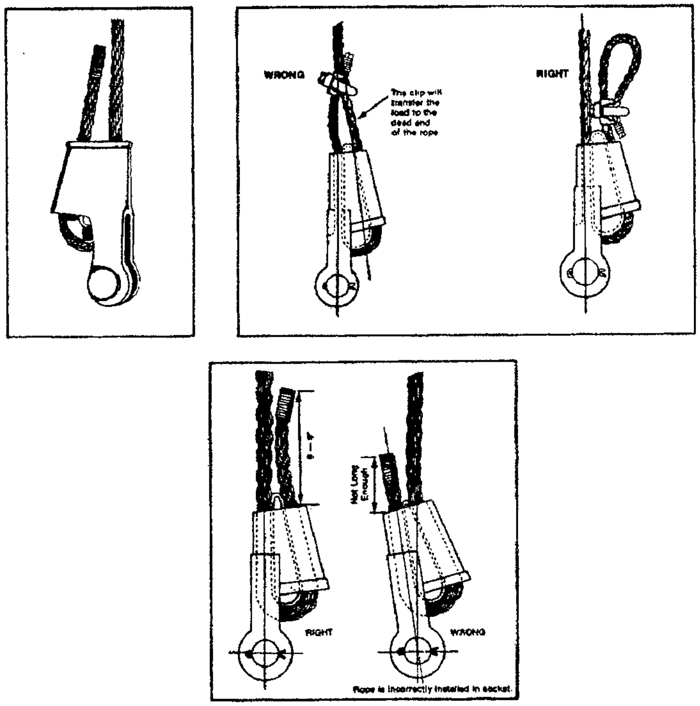


Fig. 2-17 The wedge socket
Rigging Manual, D.E. Dickie, P.Eng. Construction Safety Association of Ontario, Oct. 1975.

section of the piece the swivel must be replaced.

13. Rigging Links. The rigging links between the hook and swivel are generally made of alloy steel. Consequently, they must be inspected for nicks, gouges, wear and deformation semiannually. Nicks and gouges, which can cause stress risers, must be ground out. If after grinding, or due to wear, the link's cross-section has been reduced by 10 percent or more, the link must be discarded. If links are bent more than 10 degrees from their original plane they must be discarded.

14. Sheaves.

  a. Grooves in sheaves should always be larger than the actual diameter of the wire. Inspect the sheaves bi-annually and each time a new wire rope is installed. The sheaves must be inspected for proper support of the rope, cracks, and scoring. The proper support is determined with a sheave gauge. Use a "no-go" sheave gauge to determine if the proper support is supplied by the sheave. Proper support range is 135 to 150 degrees of support. (See **Figure 2-18**.) If the sheave has worn too narrow for the rope, then the tension on the rope will pull the rope into the groove causing it to be pinched and subject to significant wear. If the sheave groove has become too large the rope will flatten, which causes severe bending stress and fatigue failure.

  b. A sheave groove becomes smaller, not larger, through use. If the "no-go" gauge indicates that the sheave does not provide adequate support then it must be resurfaced or replaced. The groove surface on the sheave should be perfectly smooth. If the surface has become scored with the imprint of the rope, it will no longer allow the rope to slide and flex. Resurface or replace a scored sheave; replace a sheave with cracks.

M. Slings.

1. General. Wire rope slings, chain slings, and synthetic slings are used in the lifting and moving of large bulky objects. All slings should be bought or constructed expressly for that purpose. The slings shall be proof tested by the supplier and tagged with their safe working loads. If constructed by the unit, only heat treated alloy chain and fittings and only new wire rope or chain shall be used. The sling components shall have a SWL equal to or greater than the chain or wire rope. The SWL of wire rope used in slings is based on a safety factor of 5 to 1. The SWL of chain and synthetic slings is determined by the manufacturer. Synthetic sling identification tags on chain and wire rope slings shall be metal, leather or plastic. They shall have the size of chain or wire rope, reach, type sling, SWL at a specific angle and an identification number for record purposes. Store all lifting slings away from oil, chemicals, and dirt. The preferred method for storing slings is to hang them up when not in use. Lubricate wire rope slings in the same manner as wire rope rigging; inspect and replace as described under the applicable chain or wire rope sections. The following is a list of sling definitions:

  a. Basket Hitch -A sling configuration where the sling is passed under the load and has both ends attached to the lifting hook.

b. Braided Wire Rope - A wire rope formed by plaiting wire ropes together.

c. Bridle Wire Rope Sling - A sling composed of multiple wire rope legs with the top ends gathered on a master link or other fitting that attaches to the lifting hook.

d. Cable Laid Endless Sling - Mechanical Joint -A wire rope sling made endless by joining the ends of a single length of cable laid rope with a metallic fitting.

e. Choker Hitch - A sling configuration with one end of the sling passing under the load and through an end attachment, handle, or eye on the other end of the sling.

2. Wire Rope Slings. Most wire rope slings are used on board tenders and at bases for hoisting bundles of chain, small buoys, vehicles, and boats. Some tenders use a braided wire pendant, fitted with a thimble at one end and a hook at the other, for handling small lighted and unlighted buoys.

a. 6x19 improved plow steel wire rope slings are excellent. Their flexibility makes them ideal for sling use, particularly for ropes up to 1 1/8 inch in diameter. Rope with a steel center is recommended in sling construction.

b. Braided Wire Rope Slings.

(1) Slings manufactured by braiding eight small wire ropes together offer greater strength for their weight than most other types of cargo handling slings. They have greater flexibility, and no tendency to unlay under load. They are slightly more bulky than equivalent slings of single wire rope. Two types of these slings are found aboard large tenders. The first is a simple sling with thimble at one end and a hook at the other, used for hooking onto smaller buoys. The second is a sling with a thimble at each end and a traveling choker hook, suitable for lifting heavy cylindrical loads such as can and nun buoys (horizontally). The greater flexibility of these slings makes them useful for a variety of cargo handling applications.

(2) **Tables 2-9 and 2-10** give the sizes and rated loads for braided wire rope slings. They require the same care as other wire rope equipment, and must not be bent around sharp corners, overloaded or stowed where they will be exposed to moisture.

c. The most important consideration in using slings is the angle between the sling and the horizon. As this angle is reduced the load in the sling leg is increased.

d. No sling should be used that results in an angle between the sling leg and the horizon less than 30 degrees. **Table 2-11** shows the load increase in a double-legged sling, as the angle is reduced. To determine the actual load from this table, multiply the weight of the load by the angle factor for the corresponding angle. Your sling will need an SWL equal to or greater than the product. Example: 500 Lbs X 1.414 (45 degree angle factor) = 707 Lbs

3. Chain Slings. Never use a chain sling when it is possible to use wire rope. The failure of a single link of chain can result in a serious mishap. However, all the wires

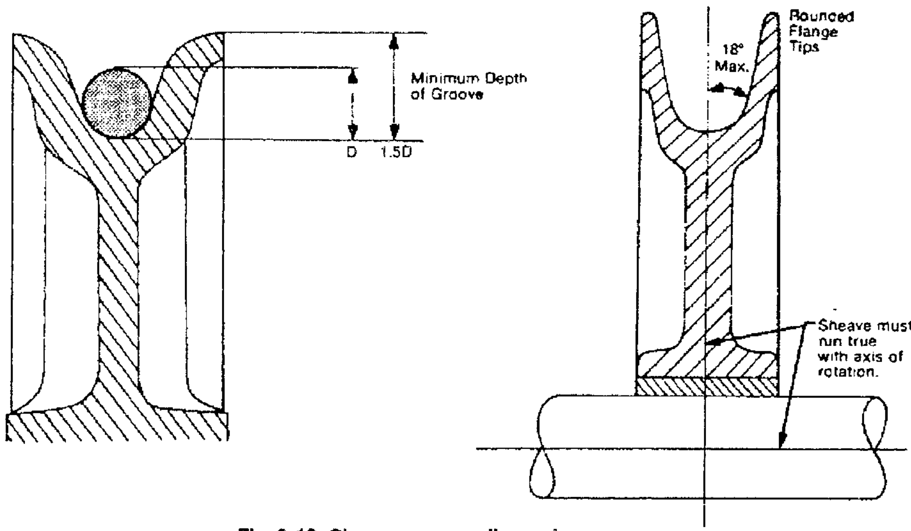


Fig. 2-18 Sheave groove dimension

Size 8 parts of (inches)	Rated Capacity Choker Hitch (pounds)
1/4"	4,600 lbs
5/16"	7,200 lbs
3/8"	10,200 lbs

Table 2-9 Safe working loads for braided wire rope slings with large thimble at one end, small thimble at other, and traveling choker hook

Size 8 parts of (inches)	Rated Capacity Straight Lift (pounds)
1/4	6,200
5/16	9,600
3/8	3,600
7/16	18,600
1/2	24,000
9/16	30,000

Table 2-10 Safe working loads for simple braided wire rope slings, thimble or served loop on one end, hook on the other

Sling Angle	Load Angle Factor
90°	1.000
85°	1.004
80°	1.015
75°	1.035
70°	1.064
65°	1.104
60°	1.155
55°	1.221
50°	1.305
45°	1.414
40°	1.555
35°	1.742
30°	2.000
25°	2.364
20°	2.924
15°	3.861
10°	5.747
5°	11.490

Table 2-11 Sling angle load factors

in a wire rope must fail before the sling fails. All chain slings must be constructed from heat treated alloy chain. Alloy chain will have an A stamped on the links.

4. Inspection. Inspection procedures for chain are contained in the section of this chapter on chain.

5. Synthetic Slings. Synthetic slings are a recent addition to the rigging scene. They are constructed of man-made fibers which offer tremendous strength for very little weight. However, these slings do require more care in stowage and inspection than other types of slings.

   a. Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.

   b. Synthetic slings shall be repaired only by a manufacturer of a similar entity. Repaired slings must be proof tested before being placed back into service. Units will not make temporary repairs to web slings.

   c. Synthetic slings are highly susceptible to damage from acids and caustics. They should not be used or stored where acids and caustics are found in any form.

6. Inspection of Synthetic Slings. Complete information on inspection of synthetic slings is found in *Naval Ships' Technical Manual*, Chapter 573. However, web slings shall be immediately removed from service if any of the following conditions are present:

   a. Acid or caustic burns.

   b. Melting or charring of any part of the sling surface.

   c. Snags, punctures, tears or cuts.

   d. Broken or worn stitches.

   e. Distorted fittings.

N. Blocks and Tackles.

1. Blocks. Blocks are classified according to their number of sheaves as single, double or triple. Blocks may also take their names from their use, some peculiarity of shape, or from the place they occupy. The size of blocks used with fiber rope is determined by the length of the cheek or shell. **Table 2-12** is a partial summary of this information.

2. Tackles: Some of the common tackles used aboard ships are (See **Figure 2-19**):

   a. Single Whip. A fixed single block with a line rove through it, one end of which is secured to the weight to be moved. Since there is no movable block, it does not multiply the force applied. It does change the direction of pull and furnish a convenient method of hoisting.

   b. Runner. A single movable block attached to the load. The part of the line running from the block to a fixed point is the standing part. The mechanical advantage is 2:1.

c. Whip and Runner. Two single blocks, one fixed, but not over the load, and one block attached to the load. The mechanical advantage is 2:1.

d. Gun Tackle. Two single blocks, one fixed over the load, the other attached to the load, the standing and the hauling parts leading from the same block. Mechanical advantage is 2:1 or 3:1, depending upon which block is attached to the weight.

e. Luff, Jigger, or Watch Tackle. A double and a single block. When the single block is attached to the weight, the mechanical advantage is 4:1. A combination of a triple and a double block with the standing part secured to the becket of the lower (double) block is known as a double luff tackle.

f. Two-Fold Purchase. This consists of two double blocks with the standing part and hauling part coming from the same block. The mechanical advantage is 4:1 or 5:1.

3. Type of Blocks. Blocks most commonly used on tenders are wooden or metal, snatch, single, and double blocks. Snatch blocks are one of the most useful types of blocks found on board a vessel since they can be easily moved. This block may be employed conveniently as a lead block since it is fitted with a hinged shell so a line may be easily snatched on a bight. In using this block, take care to see that the block is properly secured to prevent its opening at the wrong time. **Figure 2-20** is a picture of a snatch block.

4. Safe Working Load. The safe working load of a tackle is commonly accepted as being the safe working load of the line multiplied by the number of parts of line at the moving block. The overall strength is therefore assumed to increase in direct proportion to the number of sheaves. This method of calculation only works if the SWL of the blocks which make up the tackle are known. For this reason only blocks which have the SWL stamped on the block by the manufacturer, or have been tested in accordance with *Naval Ships' Technical Manual* Chapter 573, shall be used.

5. Stowing Tackle. To make up a deck tackle for stowing, haul through the falls until the blocks are 3 feet apart. Place the blocks flat on the deck and coil the hauling part of the fall on top of the lines between the blocks. Then clove hitch the end of the fall around the whole tackle between the blocks. The tackle can then be stowed, carted about, or cast loose and fleeted or overhauled, without danger of jamming.

O. Hooks.

1. General. All load lifting hooks shall be made of alloy steel. All hooks must be properly rated for the rig in which they are installed. Only forged hooks shall be used. Hooks shall be inspected before each use and semiannually for wear in the saddle and eye, cracks or gouges, and twisting and opening. Cracks and gouges, which cause stress risers, should be ground out. The result should be a smooth surface. Where normal wear or the removal of cracks and gouges results in a reduction in the original dimension of 10 percent or more, the hook shall be discarded.

Size Block (ins)	Rope Circum (ins)	Single with becket	Single without becket	Double with becket	Double without becket	Treble with becket	Snatch drop lines
4	1 3/4	1550	1100	2350	——	——	——
6	2 1/4	2450	1700	3700	3100	4700	3000
8	3	4050	2850	6150	5150	7850	5000
10	3 1/2	5400	3800	8200	6900	10400	8000
12	4	6800	4750	10200	8600	13000	10000

Table 2-12 Summary of rope size and safe working loads for various fittings and block combinations

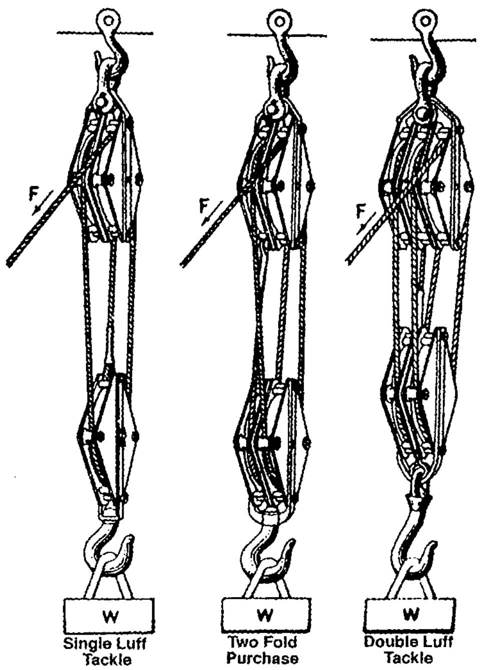
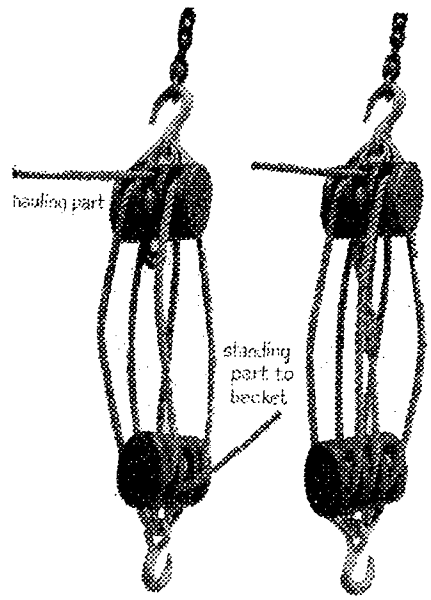


Fig. 2-19 Rigging Options



Rigging three-fold purchase

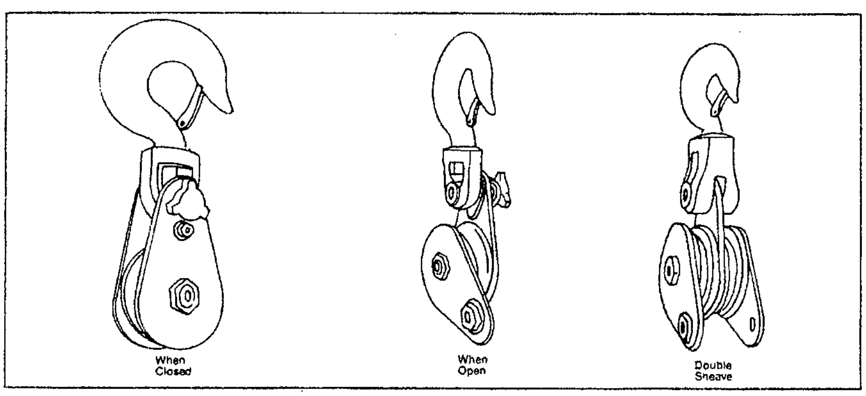


Fig. 2-20 Snatch block

2. Tolerance. Hooks which have bent 10 degrees from the plane of the unbent hooks shall be discarded (See **Figure 2-21**).

3. Measurement. Hooks shall be measured for throat opening before installation. A throat dimension base measurement shall be established by installing two punch points minimum (one below the eye, the other on the hook point) and measuring the distance between them. Crane and boom power weight handling system hooks shall have the throat dimension retained in the hull history record file for the life of the hook. All other weight handling hook throat dimensions shall be retained in the auxiliary weight handling log book. If at any semi-annual inspection the throat dimension has increased by 15 percent of the original measurement the hook shall be discarded (See **Figure 2-21**). To ensure that discarded hooks are not used any further, they should be cut or disfigured before discarding.

4. Safe Working Load. Most boom/crane systems are designed with the hook as the weak link. Hooks, like other rigging items, have safe working loads. These are based on the load necessary to straighten the hook, not break it. Welding or heating on hooks may have serious detrimental effect on the hooks. Like wire rope, the extent of the heat affected zone is not known for hooks. The heated area on the hook will not be able to accept the same amount of stress after welding as when it was originally designed. Therefore, only modifications of cargo hooks by ship's force in accordance with CG plan FL-1701-11 is authorized. This allows a safe method of securing a line to a cargo hook for use with a line-reeving hook.

P. Pelican Hooks.

1. General. Pelican hooks are extremely useful in stopping off chain. Originally designed to secure a ship's anchor at the hawse pipe, pelican hooks are not required to have a SWL stamped on them. It is generally held that the hook will safely hold any load that any proper sized chain, regardless of type, will hold.

2. Design. Pelican hooks 1 1/4" and smaller are designed to hold two sizes of chain, the size for which they are rated and next size 1/8" smaller. Pelican hooks 1 1/2" and larger will handle the size chain for which they are rated and chain up to 1/4" smaller. A pelican hook with a worn bail may accommodate the next larger size chain, but is not safe for use with chain of even rated capacity.

3. Type. Pelican hooks in the Afloat Shopping Guide come in 7/8", 5/8", 1/2", and 5/16". The 7/8" hook will handle 7/8" and 3/4" chain, the 5/8" hook will handle 5/8" and 1/2" chain, etc. Pelican hooks listed in the Afloat Shopping Guide do not have a safe working load rating. Pelican hooks from some commercial vendors do have a safe working load listed.

4. Use. Never use any size chain either larger or smaller in pelican hooks, than the sizes they were designed to hold. Never wrap chain around the stopper to get small chain to stay in a large pelican hook. Pelican hooks are designed so one link of chain lays in the opening between the top lever (stopper) and the base of the pelican hook. The stopper is then secured by the bail.

5. Maintenance. Pelican hooks were designed to be disengaged in the upright position.

It is recommended that a strongback be attached to the pelican hook to prevent it from turning. Make sure the strongback is long enough to prevent the pelican hook from turning when it is under load. The strongback must be attached by a qualified welding technician who can attach the strongback at a constant temperature, test the metal, etc. High heat may change the properties of the pelican hook and change its safe working load because the properties of metal, including brittleness, hardness, and malleability, are determined by alloy content and temperature. Commercial suppliers may perform the job before delivery, in which case they should provide a proof test on the pelican hook. If in doubt, have the pelican hook annealed as you would the hook on a boom or crane that had hot work performed on it.

6. Positioning. Pelican hooks are meant to be situated on deck so the individual hitting the bail swings inboard with the maul. Orienting the pelican hook so you swing outboard may result in the person tripping the bail being carried overboard by the weight of the maul.

7. Weight Tests. Pelican hooks are a weight handling device and must be weight tested annually. Pelican hooks without a known safe working load should be tested at 1.25 times the SWL of alloy chain of the appropriate size. In addition they must be inspected before and after each use to insure they are fully functional. Only heat treated alloy chain and shackles may be used to secure a pelican hook to the deck. Since the chain and shackles are a single leg chain sling, a metal tag with the safe working load, size of chain, and an identifying number for record keeping must be attached. It is a good idea to follow the same procedure for marking the pelican hooks.

Inspections should ensure:

a. That the retaining pin makes contact with both sides of the releasing bail;

b. That the releasing bail rotates easily; and

c. That the hook rotates easily and is aligned with the base. If these conditions are not met, take corrective action or replace the pelican hook.

Q. Tie-Downs.

The proper securing of buoys and other deck cargo is essential to a safe and efficient operation. Grade 7, or higher, chain and steamboat jacks shall be used to accomplish this. Use saddles and headblocks on lighted buoys that lie on deck. Unlighted buoys must be chocked to prevent them from rolling. Gripe buoys on both ends to prevent them from working loose. On all gripes, lead angles should not only pull the object to the deck, but also restrain it from moving from side to side. The SWL of gripe down chain needs to be calculated in the same manner as sling angles. Buoy counterweight tubes were not designed as gripe holds. Gripes should be attached at unused mooring/lifting eyes as these were designed to hold substantial loads. Round bulky objects such as buoys can be difficult to secure, and no set rules can be laid down as to exactly how a gripe shall be set. All gripes must be inspected regularly.

R. Shackles.

1. Buoy Shackles. Buoy shackles, like buoy chain, are made from the lowest grade of

steel available. There are no safe working loads associated with buoy shackles since they were not designed to be used in lifting situations. Buoy shackles are designed and sized to connect a buoy mooring together, lift or lower it and connect it to the buoy. They shall not be used for any other purpose on Aids to Navigation vessels.

2. Rigging Shackles. Rigging shackles are made of alloy steel in the screw pin or bolt pin styles. These shackles are designed to handle loads up to their specified safe working loads without deformation or damage. Rigging shackles shall be used in all loading operations.

3. Modeer Shackles. Modeer shackles are specially designed shackles for the handling of stud link chain. These shackles are meant to replace nipper chains which can slip and spill. Modeer shackles are narrow, elongated shackles with a removable keyed pin. To use the shackle, remove the pin and slip the shackle over a link of the chain. Keyed into the shackle, the pin gives a positive lock while under strain, but is easily removed when there is no strain. Because of the shackle's narrow shape, the chain cannot slip through it. Due to its elongated shape, there is room in the shackle for the boom hook after the shackle is in place over the chain (See **Figure 2-22**).

S. Chain.

1. General. Aids to Navigation vessels use open link and stud link chain. Alloy, sling and tie-down chains are also open link. Open link chain is any chain that does not have an obstruction through the link (See **Figure 2-23**). The major differences between buoy chain and alloy chain are the steel and the shape of the links. Buoy chain is made from carbon steel grade 1010 or better (basically a low cost bendable steel). Alloy chain is made from alloy steels, usually 4600 or 8600 grades. These have much higher breaking strengths than carbon steels. The carbon steels are used for buoy chain because the strength is adequate for mooring buoys and because of its low cost. Buoy chain shall not be used in slings or to secure deck loads.

2. Inspection. The inspection and replacement criteria for buoy chain is quite simple. The major cause for replacement is the reduction in the wire diameter due to wear. Table 2-13 in the Aids to Navigation Manual - Technical, Commandant Instruction M16500.3 (series) - contains the buoy chain rejection.

3. Open Link Chain. Open link chain is made by cutting a piece of bar steel to the appropriate length to form a link, heating the bar to red hot, then bending it into the link shape. First, a J shape is made and then a nearly closed C shape by bending the straight end 180 degrees. Next follows welding, usually done by placing the link in a device which is both a press and welding electrodes. The electrodes are energized and the press pushes and the two ends of the bar "melt" together. This is known as resistance welding. The gap in the link could also be hand fillet welded. After welding, the weld slag is removed either by an automated process or manually with a chipper. The next link in the chain is added by lacing the J shape through the one just made. Most small chains, 7/8 inch and below, are made by a continuous automatic process.

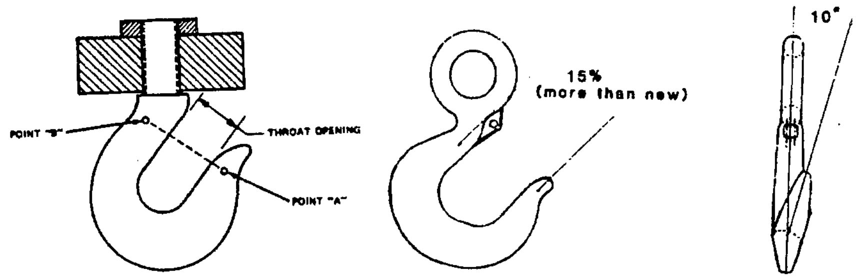


Fig. 2-21 Hook problems

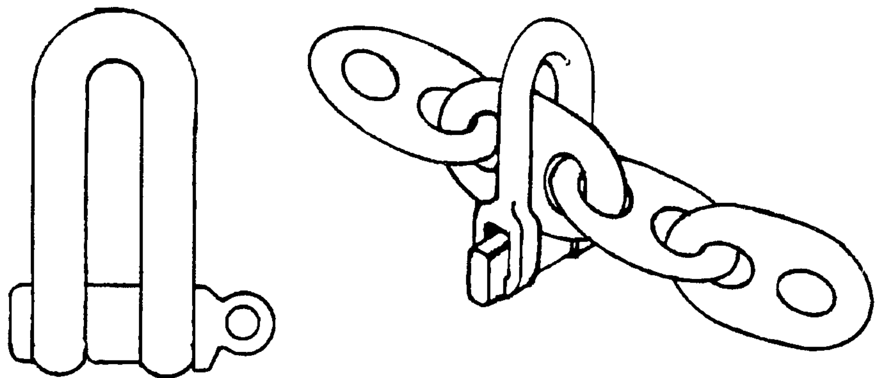


Fig. 2-22 Modeer shackle illustration and use

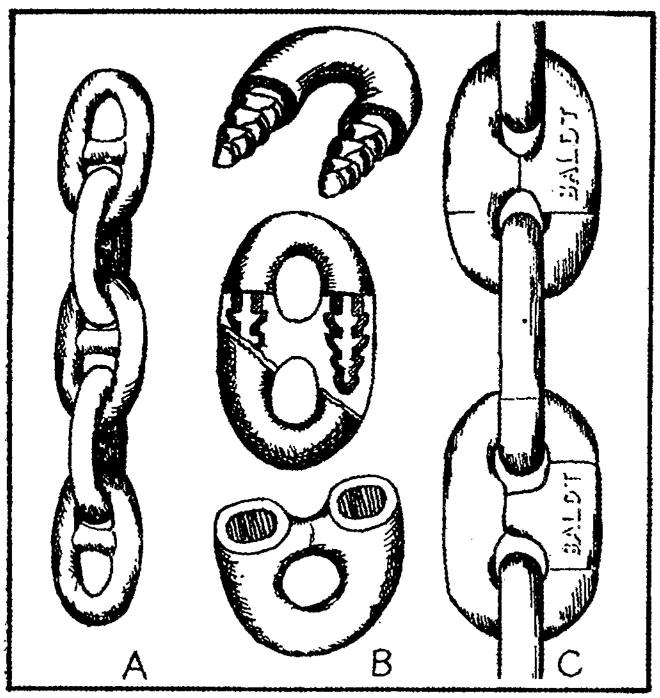


Fig. 2-23 A) Stud-link Chain. *B*) Di-Lok Link Before and After Joining. *C*) Di-Lok Chain Joined With Detachable Link.

4. Stud Link Chain.

   a. A stud link chain can be of two different styles; stud link or die lock (See **Figure 2-23**). Stud link chain, because it has a higher breaking strength than buoy chain, is also used for mooring Large Navigational Buoys. Open link chain can deform or stretch when under heavy strain, as in breaking out an anchor or sinker. The open link chain will deform into a shape known as a peanut (See **Figure 2-24**). If a peanut-shaped link were hauled into a wildcat, it would not fit. The stud in stud link type chain prevents this peanut shape by keeping the barrels a given distance apart. Stud link chains fail without deforming a significant amount. Stud link chains are made of alloy steels usually grade 8600 or better. Use stud link chain for anchoring or mooring chains, where they will be lifted using a wildcat.

   b. Various methods are used for putting a stud in a link. The different methods were developed to keep the stud in place for long periods. As the chain is alternately strained and slackened, as caused by a seaway, the links flex slightly. How the stud is installed will have a big effect on whether this flexing causes the stud to fall out. Currently the methods used to put in the studs are called inserted, welded (one or both ends), integral and die lock.

   c. To make stud link chain, open link chain is made slightly wider between the barrels than the desired final size. The stud, which has been forged into shape in another process, is then held between the barrels while they are squeezed together. This is inserted stud link chain. Welded stud link chain is made by welding one or both ends of the stud in place.

   d. Integral stud link chain is made by forging one end of the bar stock over nearly 90 degrees, then bending the rest of the stock around this stud to form a link (See **Figure 2-23**). In this way the stud is part of the link itself and will not fall out.

   e. The inspection and replacement criteria for stud link type vessel anchor chain is contained in Chapter 581 of the *Naval Ships' Technical Manual*. That manual states that once 10 percent of the bar diameter has been worn away, the chain must be replaced. When stud link chain is used for LNB moorings, replace it when the maximum wear reaches 13 percent of the bar diameter. The chain should also be replaced if loose studs are found.

5. Die Lock Chain. Die lock chain is made entirely by forging; there is no welding involved. It was developed by the U. S. Navy to be a chain in which the stud could never fall out. The chain is made from two pieces of bar (See **Figure 2-23**). The larger of the pieces is forged into a U shape. It is forged again to create tapered holes in each end and the excess material is shaped into a stud. The shorter bar is also forged into a U shape and then forged so its ends are tapered to mate with the first piece. The two U shapes are brought together and forged making the female section grasp the male.

6. Bridles and Swivels.

   a. Many buoy moorings (all lighted, most unlighted) include a bridle and a swivel attached between the buoy and the top end of the mooring.

b. The bridle is two short lengths of chain connected by an iron ring.

c. A swivel is a pair of adjoining links, one of which may turn independently of the other.

7. Break Strengths.

a. The break strength of chain depends on the size, grade of steel and type. The larger the size, all else being the same, the higher the breaking strength. The higher the grade of steel, size and type being the same, the greater the break strength. Open link chain, the size and grade the same, will have a higher break strength than stud link chain. This is because open link can deform and absorb more load. Keep in mind that open link buoy chain is made from low strength carbon steel. The stud link chain, for vessels and LNBs, is made from alloy steels and heat treated during manufacturing. A link with a stud removed should never be used in LNB or vessel moorings. All chain is designed to be loaded on the ends (in the pull). Sideloads on chain greatly reduce the breaking strength. Chains shall never be sideloaded.

b. The removal of a stud weakens stud link chain. When studs are pressed in place they often create depressions or indentations in the hot bar stock. If the stud is removed the indentation is no longer filled with steel and becomes a stress concentration point. A stress concentration point on the inside barrel of a link, a high stress area, will cause failure below break strength. The removal of a stud, because of the cup shaped ends of the studs, also causes a slight, permanent deformation opening, of the link. This changes the stress distribution and lowers the load at which failure occurs.

8. Detachable Links. Stud link chains and die lock require detachable links as connecting hardware. Anchor joining links are used where connections must be made to larger objects, anchors and LNBs. Hairpin detachable and anchor joining links are used on LNB and vessel outboard swivel shots.

a. The detachable link consists of a C-shaped link, two side/stud plates, a tapered pin, a lead plug and a hairpin (See **Figure 2-25**). On each end of the C-shape is a button. The side/stud plates are made so they grip the buttons and hold them from spreading under a load. To keep the plates from falling apart, a tapered pin is driven through the eyes on each plate and into the stud hole. The tapered pin is grooved and the plates drilled to accept the stainless steel hairpin. The hairpin and the lead plug are used to retain the tapered pin.

b. Care must be taken to ensure that the side plates are properly attached to the C-shape. Note that a number is stamped on top of the C-shape and each plate. The same number can be found on the tapered pin of hairpinned links. Although these pieces may look interchangeable, they are not. All the pieces must have the same number. Install the plates with their numbered corners meeting the numbered end of the C-shape (See **Figure 2-25**).

T. Mooring Lines.

Mooring lines are subjected to a great deal of strain while mooring and unmooring the vessel. The angle of pull and the shock loading forces often applied to these lines are usually never considered. However, as we come to understand the physics of working with line we also realize there is greater need to pay attention to small details. The size of bitts, the angle of pull on mooring lines and the size of the eye spliced in the mooring lines are all important. Specific information on inspecting mooring lines is contained in the fiber rope section of *Naval Ships' Technical Manual*, Chapter 613. Listed below are three considerations that should always be kept in mind when working mooring lines.

1. <u>Characteristics</u>. Any sharp bend in a rope, under load, decreases its strength.
2. <u>Usage</u>. Where a rope bends more than 10 degrees around bitts or chocks or is bending across any surface, the diameter of the surface should be at least three times the diameter of the rope. (See **Figure 2-26**.)
3. <u>Eye Splices</u>. The ratio of the length of an eye-splice to the diameter of the object over which the eye is to be placed (bollard, bitt, cleat, etc.) shall be a minimum of 3 to 1, preferably 5 to 1. If you have a bollard two feet in diameter, the eye splice should be six to ten feet in length (See **Figure 2-27**). By using this ratio the angle of the two legs of the eye-splice, at its throat, will not be so severe to cause a parting in the eye.

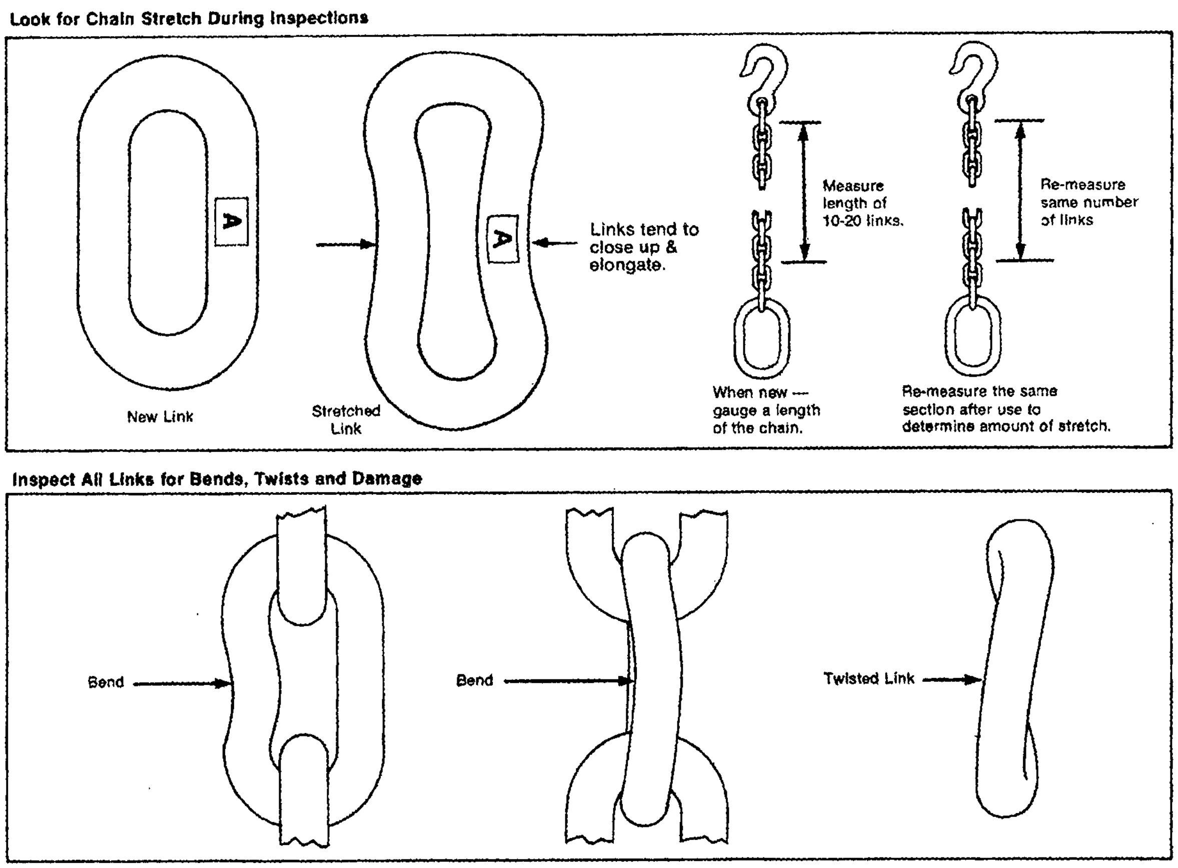


Fig. 2-24 Deformed chain links

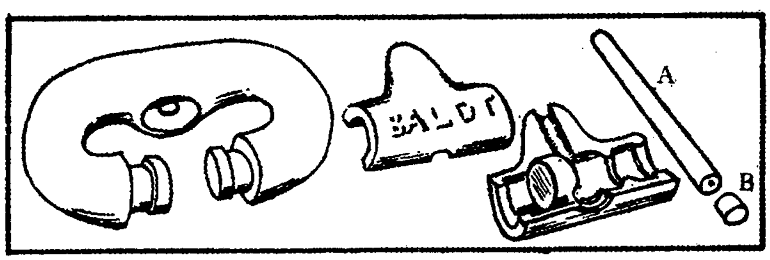


Fig. 2-25 Detachable line (and installation)
Merchant Marine Officers Handbook

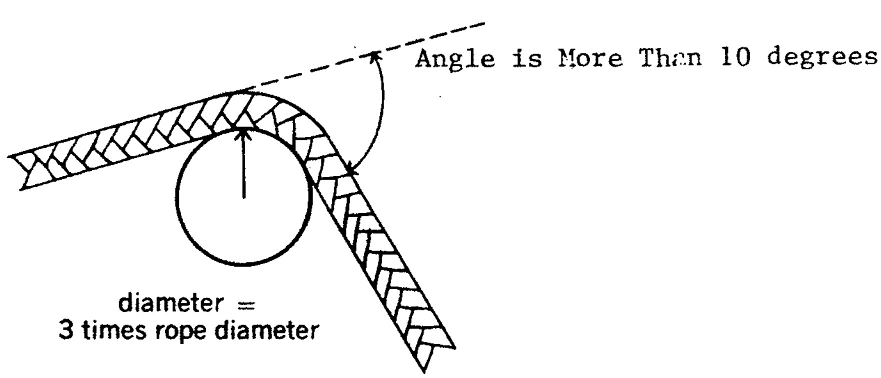


Fig. 2-26 Mooring line around a bitt

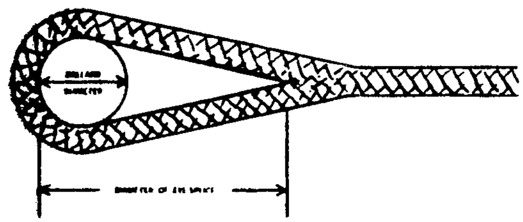


Fig. 2-27 Mooring line eye dimensions

CHAPTER 3: AIDS TO NAVIGATION TOOLS

A. Hand Tools - General.

Aids to Navigation maintenance has evolved over the years. Tools have changed and some have been invented to accommodate a procedure that is not done anywhere else. Buoy-tending personnel's background has also changed. Previous exposure to tools is no longer something to be taken for granted. This chapter is an elementary explanation of some tools used on tenders. It is designed to give new seamen an idea of what certain tools are called and what they are for.

1. Line Reeving Device. There are two basic devices used to reeve lifting hooks into buoy lifting eyes, a self-locking manufactured tool and the Second District snaphook device.

    a. Self-Locking Manufactured Tool.

        (1) The "happy hooker" is the generally preferred buoy reeving device. It is a manufactured device on the end of a long pole. The device is U shaped and has a round pressure activated metal bar across the throat. This bar is connected to a line that is connected to the lifting hook by a snaphook. The device is operated by pushing it over the lifting eye and then pulling it back aboard. The line is then reeved through the eye as the end with the line attached disconnects. Once aboard, the line is pulled to maneuver the hook into the lifting eye (See **Figure 3-1**.)

        (2) A similar mechanical reeving device can be manufactured locally, using drawing FL-2604-5.

    b. The Second District snaphook reeving device is mounted on the end of a boathook. The hook is locked open and has a line attached. The hook is pushed over the lifting bail releasing the snap. It is then pulled back toward the ship and slides off the pole. The line is then taken to the deck winch and used to hoist the buoy aboard the tender.

2. Chain Hook. Chain hooks are made of steel, about three feet long with a handle large enough to accommodate a hand. The hook is like that found on a meat or bale hook. The chain hook is the preferred method for personnel to use in moving chain around on deck. Personnel do not have to bend over to move chain and the hook prevents injuries to the person's hands and back. The chain hooks are also used to steady chain during certain chain connecting operations on deck (See **Figure 3-2a**.)

3. Split Key Punch. These punches are usually machined from a Blacksmith's Chisel, a hammer that is flat on one side but beveled on the other. This punch is machined to produce a rectangle on the beveled side that is 2 1/8" high, 3/8" thick and 1 3/8" wide. This punch is used to knock 1st, 2nd, and 3rd class split keys out of split key pins (See **Figure 3-2b**.)

4. Blacksmith's Punch. This hammer is square on one end and has a round flat tip on the other. It is used to drive the pin out of a shackle after the key has been removed.

This is also called a pin drift hammer (See **Figure 3-2c**.)

5. Sledge Hammer. Sledge hammers come in various weights and are flat on both ends. They are used to trip the mechanical chain stop, trip the pelican hook bail, set the chain in the chain stop, perform heat and beats, and to set wedges around a buoy on deck (See **Figure 3-2d**.)

6. Blacksmith's Chisel. This hammer is flat on one end and beveled on the other. It is sometimes called a split key hammer. It is used to spread the key, a large flat cotterpin, that holds a shackle pin in the shackle. It provides the best means of putting the required 45 degree separation in the split key. It is easiest to turn the shackle on deck, placing the blacksmith chisel into the key opening and hitting it with a blacksmith's hammer (See **Figure 3-3**.)

7. Blacksmith's Hammer. A large hammer, weighing approximately two and a half pounds, flat on both ends. This hammer is used with the blacksmith's punch, chisel, and split key punch. Those tools are lined up with the appropriate item and struck with the blacksmith hammer (See **Figure 3-3**.)

8. Heat and Beat Anvil. This anvil weighs about 100 pounds. Some are round with handles on the side so they can be moved easily around deck. Others are either rectangular or square. The purpose of the anvil is to provide a surface where solid shackle pins can be heated with a torch and peened over with a sledge hammer. Heat and beats are used on larger units to secure the bitter ends of two lengths of chain together. Split keys are used to attach the bridle and the sinker to the bitter ends of the chain (See **Figure 3-4**.)

9. Cant Hook. This is a tool with a thick handle and a hinged iron hook on the bottom. It is used to move pilings on deck or on the dock. A cant hook with a pointed tip is called a peavey.

B. Oxygen Acetylene Cutting and Welding - General.

1. Cutting and Welding in Aids to Navigation Work. Oxygen cutting is widely used in the repair and servicing of aids to navigation. On board tenders, shackles and chain frequently have to be cut, shackle pins heated for peening over, or damaged buoys repaired. Modern welding techniques and equipment have all but rendered gas welding obsolete, but oxygen-acetylene is still used occasionally for brazing.

2. Oxygen Cutting. The severing or removal of metals by a chemical reaction of oxygen with the base metal at elevated temperatures is called oxygen cutting. This process employs a torch and a tip or nozzle whose functions are:

   a. To mix the fuel gas and preheat oxygen in the right proportion to produce the initial heating and continuous preheating effects.

   b. To supply a uniformly concentrated stream of high-purity oxygen to the reaction zone for oxidizing and removing the molten materials. The torch unit is moved across the material to be cut at a speed fast enough to produce a continuous cutting action. This motion may be accomplished either manually or mechanically.

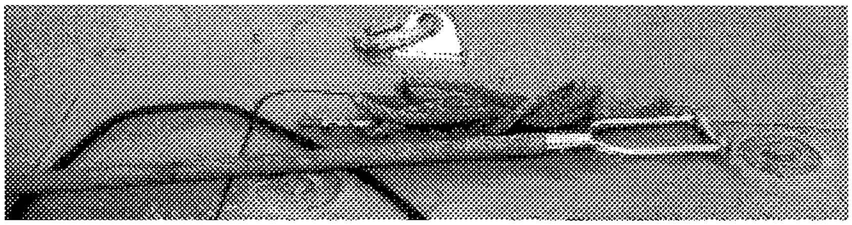


Fig. 3-1 Happy hooker

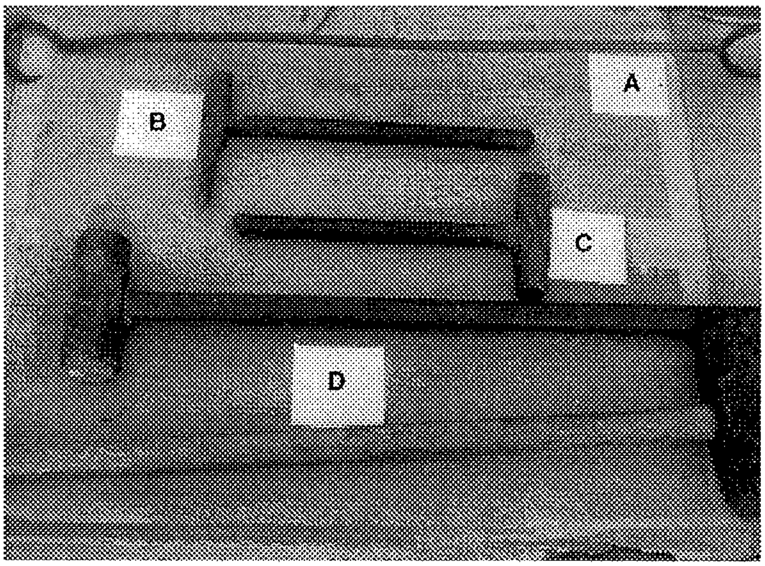


Fig 3-2 a. Chain Hook, b. Split Key Punch,
c. Blacksmith's Punch, d. Sledge Hammer

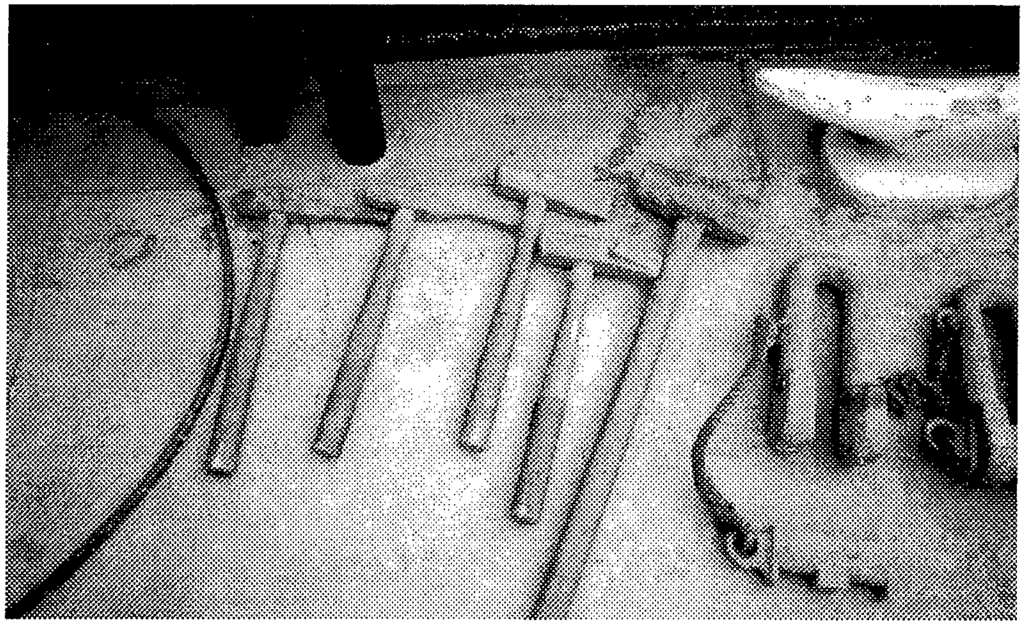


Figure 3-3 Key Punches, **Blacksmith Chisel**, **Blacksmith Hammer**, Sledge Hammer, Modeer Shackle

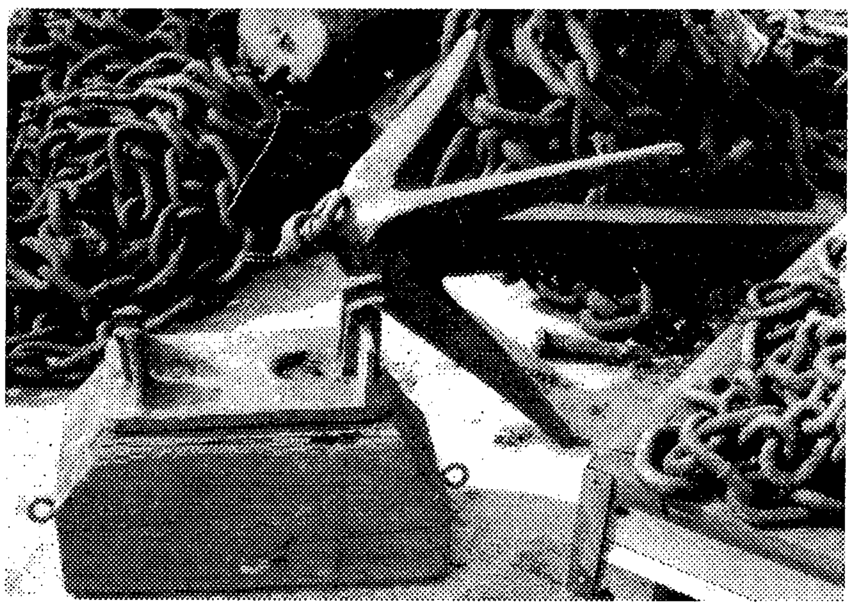


Fig. 3-4 Heat and beat anvil

The accuracy of the manual method depends largely on the skill of the operator.

3. Training Operators. The use of cutting and welding equipment involves the use of compressed gases, and can be hazardous unless handled properly. Several members of the buoy handling crew should be thoroughly familiar with the proper use of this equipment. Only qualified persons should be permitted to operate the equipment. COMDTINST M3502.12 (series) defines the minimum level of training necessary for qualification for the use of oxy-acetylene equipment.

4. Personal Safety Equipment.

   a. Personnel using a cutting outfit must wear leather welder's gloves and a leather welder's jacket or apron and goggles. Fire retardant coveralls and safety shoes are also required (See **Figure 3-5**.)

   b. Goggles are manufactured in three lens shades, light #4 and #5, medium #6, and heavy #8. Medium #6 is the lens shade used on most cutters.

5. Oxygen and Oxygen Cylinders.

   a. Oxygen is a colorless, tasteless, odorless gas which is heavier than air. Oxygen by itself does not burn or explode, but it does support combustion when combined with other gases. Pure oxygen under high pressure may react violently with grease, oil or excelsior (wood shavings).

   b. Oxygen cylinders are non-shatterable, seamless steel with a pressed steel neck ring. In the armed forces, they are green in color and subject to I.C.C. regulations. Most common types of cylinders are 244, 122, and 80 cubic feet and should be hydrostatically tested every five years at 3,300 psi. **See Table 3-1** for size and weight comparisons.

   c. Oxygen cylinders are charged at high pressure, 1,800 to 2,200 psi at 70 degrees F. If a fully charged cylinder is damaged by falling or being hit, it may burst with destructive force. Because oxygen under high pressure reacts violently with oil or grease you must keep oxygen cylinders, fittings and all associated equipment spotlessly free from oil or grease. Do not handle cylinders with greasy or oily hands. Do not store the oxygen cylinders near radiators, highly combustible materials, or other sources of heat. Never withdraw oxygen from a cylinder unless a regulator is used.

   d. Never use the term oxygen and air interchangeably, they are different and have different uses. Oxygen should never be used to power pneumatic tools, start internal combustion engines, blow out pipelines, dust clothing, or create a pressure in tanks. Only compressed air should be used for these tasks. To show the difference between oxygen and air, consider that acetylene burns in air at 1500 degrees F and when burned with oxygen produces a flame between 5,700 and 6,300 degrees F.

6. Acetylene Gas and Cylinders.

   a. Acetylene is a colorless fuel gas that has a distinct odor of sweet garlic and will burn readily. In a pure state, acetylene may become self-explosive at 30 psi. Keep it away from fire and any combustible materials. Acetylene cylinder and manifold pressures must always be reduced through gas pressure-reducing regulators. Pipeline pressures should be controlled through suitable pipeline regulators.

b. Acetylene in contact with copper, mercury or silver may form acetylides, especially if impurities are present. These compounds are violently explosive and can be detonated by a slight shock or by the application of heat. No alloy containing copper, mercury or silver in excess of 67% should be used in any acetylene system.

c. Acetylene cylinders are composed of non-shatterable seamless steel and are subject to I.C.C. Regulations. In armed forces applications, the cylinders are painted yellow and are equipped with two safety plugs that melt at 210 degrees F. Therefore, cylinders should always be protected against high temperatures and should be stored in well ventilated, clean, dry locations. Most acetylene cylinders have a rated capacity of 300, 100, or 60 cubic feet and are charged to a pressure of 250 psi. **See Table 3-2** for size and weight comparisons.

d. Because of acetylene's unstable nature, acetylene tanks contain porous materials such as charcoal, calcium silicate, balsa wood, portland cement, etc. This makes them safer and gives them a set capacity of gas. Packing cylinders with porous material allows the fine pores in the material to become filled with acetone.

e. Acetylene cylinders must be stored and used with the valve end in an upright position. When gas is taken from an acetylene cylinder that is lying on its side, acetone is readily withdrawn. This contaminates the flame and will result in welds of inferior quality. Cylinders that have been stored on their sides must be placed upright for two hours before use.

f. Do not withdraw acetylene from a cylinder rapidly as it becomes unstable when withdrawn at 15 psi or greater. Opening an acetylene cylinder valve ¼ to ½ of a turn will provide sufficient draw. Like oxygen cylinders, acetylene cylinders should be stored in a cool place. If the cylinder valve becomes covered with ice, do not attempt to thaw the ice away with an open flame or boiling water or steam. Transfer the cylinder indoors and allow the ice to melt gradually. Do not remove acetylene from a cylinder except through a regulator.

g. Be careful not to jam the cylinder valve in the open position. Tools or clothing should not be placed on top of the cylinder. They may damage the safety plugs or prevent the valve from being quickly closed in an emergency. Never attempt to transfer acetylene from one cylinder to another. When a cylinder is exhausted, close the valve and replace the cap.

WELDING OUTFIT

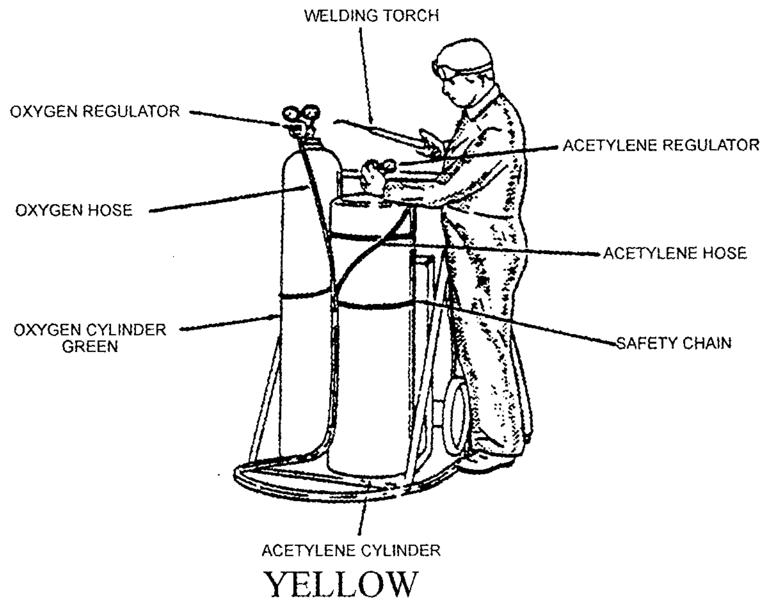


Fig. 3-5 Oxygen Acetylene Outfit

Size	Full	Empty
244 Cu ft	152 lbs	133 lbs
122 Cu ft	89 lbs	79 lbs
80 Cu ft	67 lbs	60 lbs

Table 3-1 Oxygen cylinder weights.

Size	Full	Empty
300 Cu ft	240 lbs	223 lbs
100 Cu ft	97 lbs	90 lbs
60 Cu ft	55 lbs	51 lbs

Table 3-2 Acetylene cylinder weights.

7. Handling and Stowing Gas Cylinders.

a. Cylinders can become a hazard if tipped over. The greatest of care should be exercised to avoid this possibility. It is standard practice to fasten the cylinders on a cylinder truck or to secure them against a rigid support. All hoses connecting the equipment should be kept as short as practical and free from sharp twists.

b. Cylinders of compressed gas should always be equipped with protective caps except when hooked up for use. Cylinders stored out in the open should be protected from accumulations of ice and snow, direct sunlight, and corrosion.

c. Cylinder temperatures should not exceed 120 F. Cylinders containing compressed air or gas should be segregated from empty ones. When stored, gas cylinders must be separated from oxygen cylinders by at least twenty feet, unless a steel bulkhead separates them. All full cylinders must be secured with individual collars. A bar or strap arrangement built to hold several cylinders at once is dangerous and not authorized. All cylinders, full or empty, should be handled carefully, not dropped or dragged over the pavement or deck, and should never be used as rollers for other heavy weights. Unless the cylinders are being conveyed in a welding truck the regulators should be detached and the protective cap screwed in place while the outfit is being moved. A cylinder found to be leaking should be moved out-of-doors immediately and warning signs posted. A leaking gas cylinder is a potential source of explosion. If the leak is through a valve, a regulator may be attached temporarily to stop the leak. Cylinder valves must be opened slowly and carefully; otherwise damage to the regulator may result. Compressed gas cylinders shall be carried on deck, and none below decks, even for storage.

d. Do not exhaust cylinders completely. Leave at least 25 psi pressure in each. Make sure the cylinder valves are closed tightly. Mark the empty cylinders.

e. Fuel gas cylinders, other than acetylene, also contain gas under pressure and should be handled with the same care. The manufacturer's directions for use and safety precautions must be followed.

8. Hose.

a. Reinforced rubber hose is recommended for welding and cutting operations. New hose is supplied with a talc on the inside surface. The dust should be blown out with compressed air before using hose, except the oxygen hose which should be blown out with oxygen. Flexible metal covered hose should not be used. Individual hose are supplied for oxygen acetylene. Oxygen hose is colored either black or green and acetylene hose is always red (See **Figure 3-6**.) To prevent switching, the fittings on the end of the hose have opposite threads. (Oxygen nuts are right hand thread and acetylene nuts are left-hand thread.)

b. Standard hose lengths are from 12'6" to 25'. Avoid long lengths of hose. It is better to use several standard lengths joined with special thread couplings. Standard medium hose is 3/8" inner diameter.

c. Do not permit the hose to come in contact with oil or grease. Do not use any lubricants, white lead, or pipe thread compound on the fittings. Do not leave the hose where it is a tripping hazard or is prone to kinking. Keep it free from sparks, hot slag, and hot objects. Do not tape oxygen and acetylene hoses together solidly. Use tape rings every few feet.

9. Regulators.

a. A gas regulator is defined as a mechanical device for automatically maintaining a constant reduced delivery pressure even though the inlet pressure and flow rate change.

b. There are two basic types of pressure-reducing regulators -- stem type or inlet pressure closing, and nozzle type or inlet pressure opening.

c. The cylinder outlet connections are different sizes and shapes to prevent wrongly connecting a cylinder to a regulator made for another gas or pressure. Regulators must, therefore, be made with different inlet connections to fit the cylinders. The Compressed Gas Association (CGA) has formulated a complete set of non-interchangeable cylinder valve connection standards.

d. Regulators should be used only for the service for which they were designed. Oxygen regulators should never be used for any service other than oxygen. Even traces of oil or foreign matter in an oxygen regulator can cause a violent explosion.

e. Regulator outlet fittings also differ in size and thread, depending upon the gas and regulator capacity. Oxygen outlet fittings have right-hand threads and fuel outlet fittings have left-hand threads with grooved nuts (See **Figure 3-7**.)

f. The following safety precautions should be observed when dealing with regulators:

Clean cylinder valve outlets with a clean, lint free, dry cloth and blow dust from the outlet by opening the valve momentarily before connecting the regulator to it. This is known as cracking the valve.

(1) The regulator adjusting screw should be released, or backed out, before opening the cylinder valve.

(2) Always open cylinder valves very slowly so the high pressure gas does not surge into the regulator. When doing this, stand off to one side of the regulator, rather than directly in front of it.

(3) Check gauges periodically to ensure correct readings.

(4) Adjusting screws should be turned in slowly to protect the regulator diaphragm from damage caused by a sudden surge of high pressure gas.

(5) Always use the correct size wrench to connect the regulator to the cylinder valve outlet. Never force a connection.

HOSE CONNECTIONS

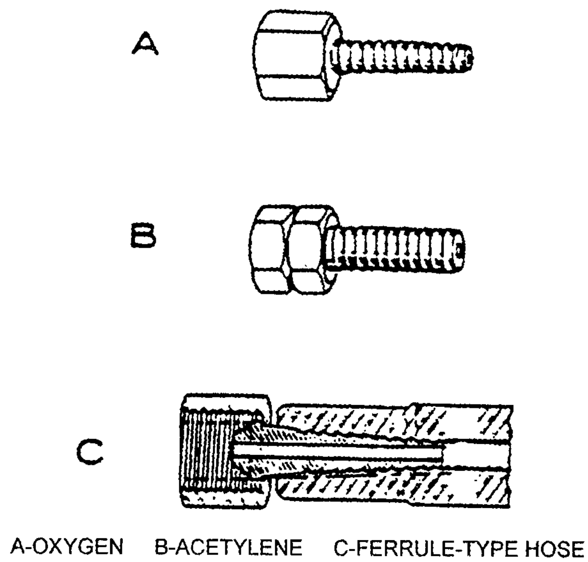


Fig. 3-6 Hose Connections

WELDING GAUGES

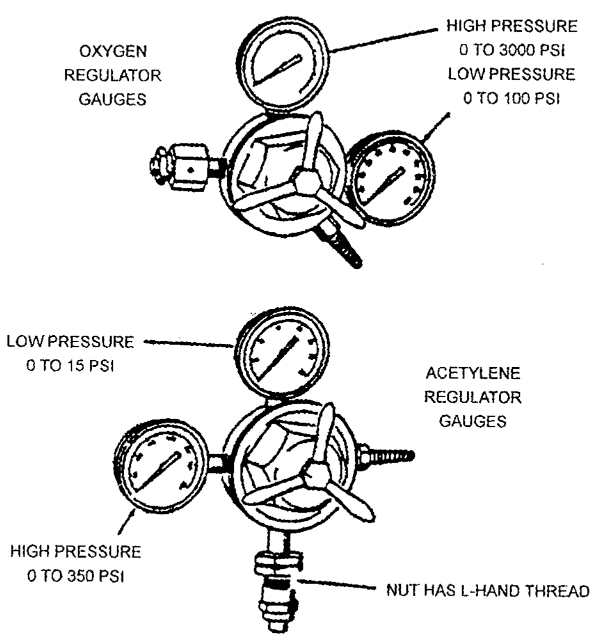


Fig. 3-7 Regulator Outlet Fittings

(6) Never use oil or grease on a regulator. A special lubricant sometimes is applied to equipment. The only lubricant that should be used is that specified by the manufacturer. Use it only when indicated in manufacturer's instructions.

(7) If a leak is suspected do not use the equipment. Refer to paragraph 11 of this section.

(8) Regulators should be repaired by qualified, trained mechanics. Only manufacturer's standard parts are to be used.

(9) Do not attempt to remove the regulator from its cylinder without first closing the cylinder valve.

g. To adjust the working pressure correctly on a regulator, open the torch needle valve and set the gas flowing. The adjusting screw is then turned until the desired pressure is shown on the gauge. If the pressure is adjusted with the valve closed, it will not be maintained when the torch is placed in operation. The pressure will fall, requiring further adjustment. Especially in cutting, where heavier oxygen flows are involved, the cutting oxygen pressure must be adjusted with the cutting torch high pressure valve momentarily held open. Unless this is done, satisfactory results cannot be obtained. Never adjust the oxygen pressure with the acetylene valve open (See **Figure 3-8**.)

10. <u>Cutting Tips</u>.

a. Cutting tips are made of copper or of tellurium-copper alloys. Whether you use a cutting torch or a cutting attachment to the welding handle, the cutting tip will be of the same general design as that shown in **Figure 3-9 and 3-10**. Notice that the cutting tip has several small orifices which surround a larger center orifice. The small orifices are for the oxyacetylene flames which are used to preheat the metal to its ignition temperature. The large center orifice is used to direct the jet or stream of high pressure oxygen that does the cutting. There are usually four or six preheat orifices in a typical cutting tip.

b. Cutting tips are furnished in various sizes. In general, the smaller sizes are used for cutting thin metal, the larger sizes for thick metal. Tip sizes are identified by numbers. When numbers such as 00, 0, 1, 2, 3 and 4 are used, the lower numbers indicate the smaller tips. For example, a 00 tip is smaller than a number 0 and a number 2 tip is smaller than a number 4. Some manufacturers identify tips by the drill size number of the orifices. Large drill size numbers indicate small orifices; for example, drill size 64 is smaller than drill size 56. In military specifications and standards, tips are identified by three-part numbers. The first part is the tip size (0,1,2,3, etc.). The second part is the drill size number of the orifice for the cutting oxygen. The third part is the drill size number of the preheat orifices. For example, the number 1-62-64 identifies a number 1 tip with a cutting oxygen orifice of drill size 62 and preheat orifices of drill size 64.

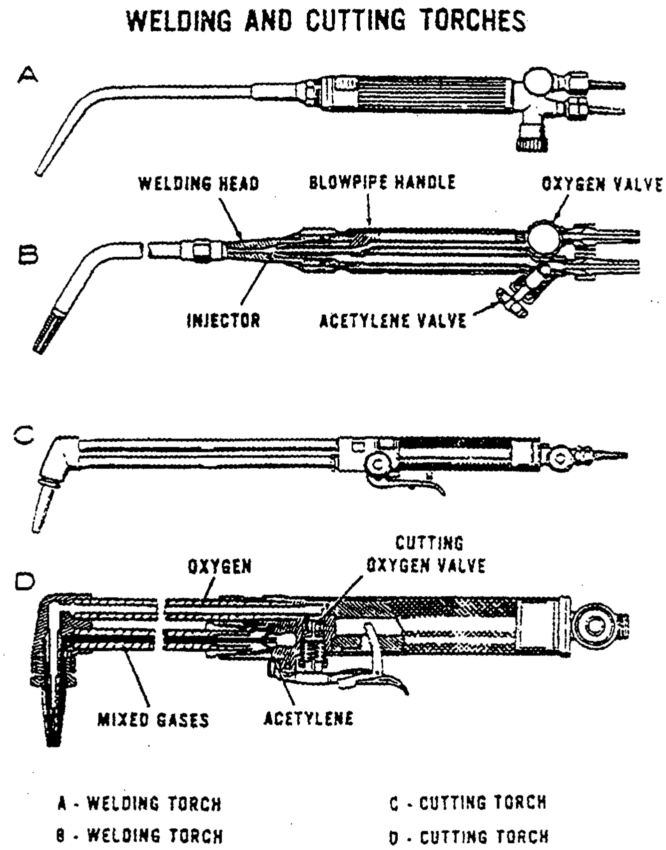


Fig. 3-8 Welding and Cutting Torches

TORCH TIPS

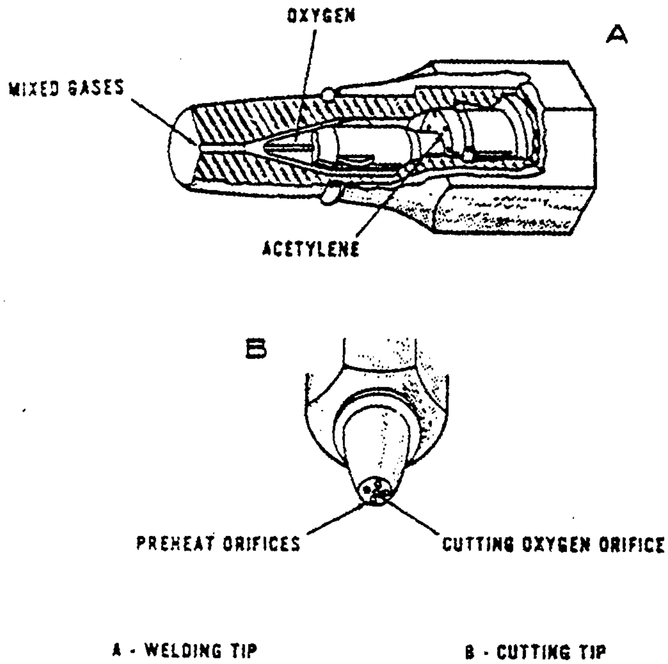


Fig. 3-9 Cutting Tip

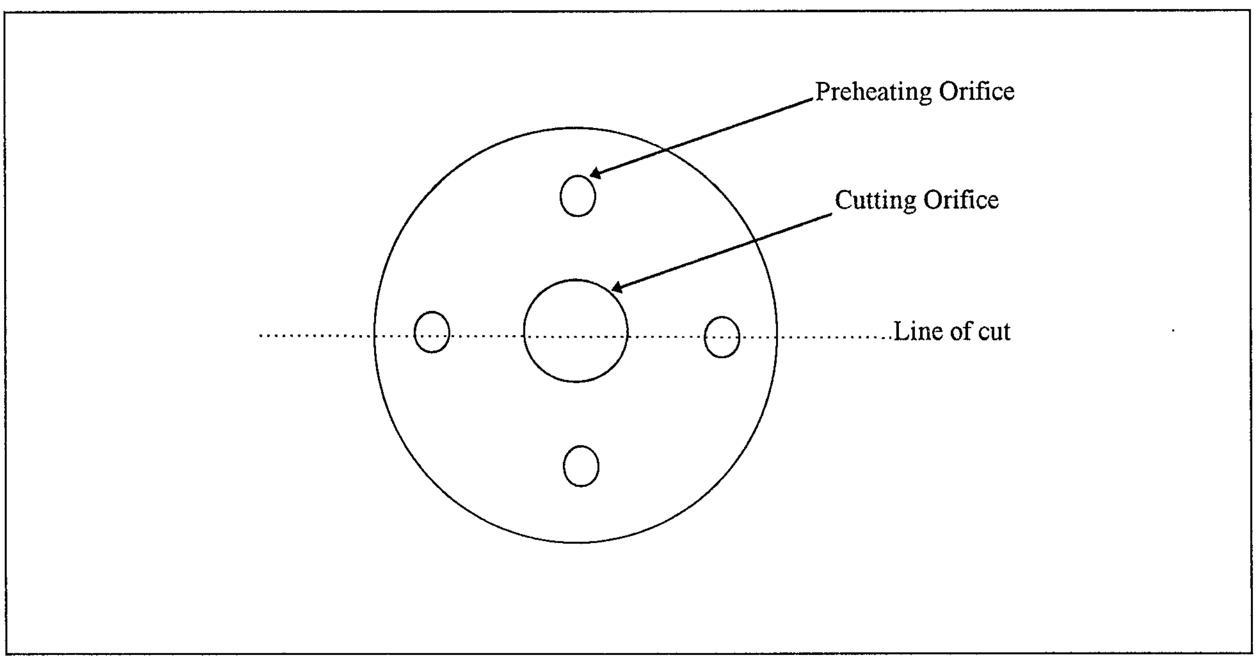


Fig. 3-10 Cutting tip cross section.

(1) The cutting tip recommended for most shipboard cutting is 2-56-62. This tip will cut most metal from 1/4 to 1 1/4 inch thick. Always use the proper size tip and working pressure for the work intended.

(2) Cutting metal involves the selection of the proper torch cutting tip to suit the thickness of the metal, adjustment of the proper flame, and the manipulative skill of the operator. Thickness of the metal is the primary guide for selecting the proper tip. However, if rust, scale, or paint is heavy, a larger tip is required, since these surfaces present greater resistance to the preheating flame. The use of oversize cutting tips and excessive pressure is not economical. **See Table 3-3** for cutting tip sizes and gas pressures for various thickness of metals (in inches).

11. <u>Checking Equipment for Leaks</u>.

a. Oxygen and acetylene gas cylinders, pipelines, valves, regulators, hose and torch connections should be checked carefully for leaks. Large leaks can be heard. Leaks between cylinder or pipeline and torch may be detected by closing the valves. If the high pressure gauge recedes, you will know that your equipment is leaking. Do not operate any cutting equipment until you are sure there are no leaks (See **Figure 3-11**). Never use a match or flame to find a leak. Ensure that all connections are wrench tight.
Note: Do not attempt to stop a leak between the cylinder and the regulator without first closing the cylinder valve.

12. <u>Operating Hazards & Response Actions & Protective Measures</u>.

a. A <u>backfire</u> occurs when the gases in the tip explode back to the point of gas mixing in the torch. It is characterized by a loud snap or pop. A <u>sustained backfire</u> occurs when the flame burns back inside the torch at the mixing point, giving a hissing sound and a thin small flame at the tip. <u>Flashback</u> is an explosion that takes place between the mixing chamber and the gas cylinders. Flashback consists of a pressure wave traveling at high speed and preceded by a flame front. Its most common cause is the backfeeding of one gas into the line of the other. Because of different pressures, if the tip is blocked, the oxygen can flow up the acetylene line, creating an explosive mixture.

(1) Backfires and flashbacks are caused by improper handling or poor equipment condition. Examples are dirty or leaking tips, internal leakage within the torch, and improper torch assembly.

(2) Never set the oxygen pressure lower than the acetylene pressure. This has been the cause of several backfires.

b. When a backfire or sustained backfire occurs, immediately close the acetylene and then the oxygen valve, in that order. If the torch tip is hot, cool it in a bucket of water. Make sure that the tip seat is not scored; replace the tip, tighten it with a wrench. Light the torch using the previous instructions and proceed with the work. If the torch flashes back, shut off the acetylene and oxygen valves on the torch as quickly as possible. And then close the acetylene and oxygen cylinder or

APPROXIMATE GAS PRESSURES FOR CUTTING WITH CUTTING TORCH
STYLES 9000, 3000, 1100, 9975-STYLE 144 TIP

Metal Thickness		3/8		3/4		1	2	3	4	5	6	6
Cutting Tip Size	0	1	1	2	2	3	4	5	5	6	6	7
Oxygen (psi)	30	30	40	40	50	50	50	50	60	50	55	60
Acetylene (psi)	3	3	3	3	3	3	3	4	4	5	5	6

Table 3-3 Pressure for oxyacetylene cutting flames.

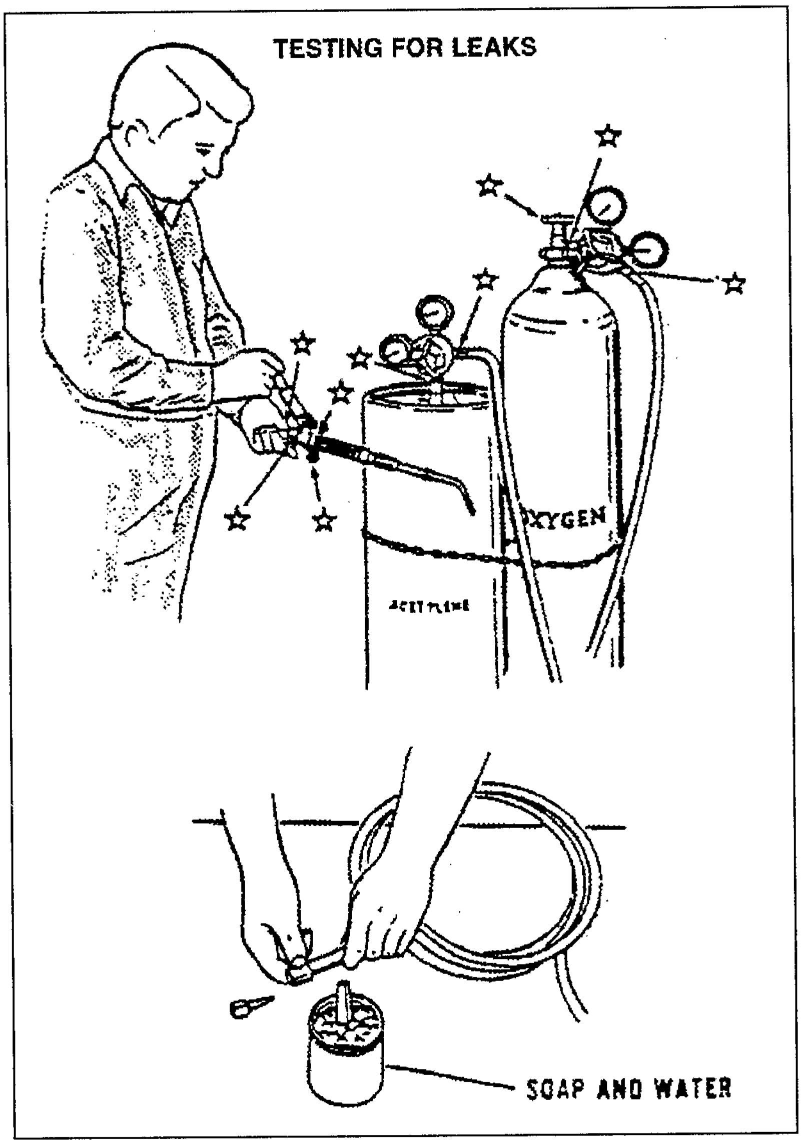


Figure 3-11 Checking Equipment for Leaks

pipeline valves. Have all regulators, hose and torch connections inspected and repaired before continuing.

c. It is important to understand that flashback arrestors and reverse flow check valves are two different types of safety devices for two different problems. Check valves prevent reverse flow of gas up the line towards the regulator. The valve requires forward positive pressure to operate. Remember, flashback is a pressure wave preceded by a flame front. Therefore, the check valve does nothing to stop the flame. It travels so fast it passes through the valve before it can close.

(1) A flame filter or flame trap must extinguish the flame front of a flashback before it reaches the regulator. A typical flashback arrestor contains not only a flame filter but also a check valve to prevent backfeeding of gas and a cutoff valve to prevent the flow of gases in the event of flashback. **Reverse flow check valves do not provide flashback protection.**

(2) All units shall ensure that their oxyacetylene cutting equipment have flashback protection. Reverse flow check valves are not adequate. Two arrestors are required, one for oxygen and one for acetylene.

(3) Check to see that the space between the work and cylinders is clear, so that the cylinders may be quickly reached in case of an emergency.

(4) When welding or cutting aloft, or in close quarters, station an attendant nearby to close the valves in an emergency.

(5) Never use oil or grease as lubricant for any part of the equipment.

(6) Cylinder caps should always be kept in place, except when the cylinder is being used.

13. <u>Recommended Basic Torch Operating Procedures</u>.

a. Before lighting off the following basic steps must be followed.

(1) Oxygen and acetylene lines must be purged to adjust the working pressure correctly on the regulators.

(2) Acetylene valve on the torch must be closed while adjusting the oxygen. To adjust the working pressure correctly, the torch needle valve must be open and the oxygen/acetylene flowing. Purge and adjust one line/regulator at a time. Begin with the oxygen valve at the torch. Open this valve and depress the trigger or lever. This will open the torch needle valve while oxygen is being released. Turn the adjusting screw on the regulator until the desired pressure is shown on the gauge. Oxygen pressure is adjusted to 40 psi for most shipboard cutting including chain, shackles and material up to 1" thick. As soon as the adjustment is made, release the trigger lever and secure the valve at the torch to complete the oxygen adjustment.

(3) To adjust the acetylene pressure, open the acetylene valve at the torch. This will release acetylene. While acetylene is being released, turn the

adjusting screw on the regulator until the desired pressure is shown on the gauge. Acetylene pressure is adjusted to 3 - 5 psi for most shipboard cutting including chain, shackles and material up to 1" thick.

b. To light the cutting or welding torch, proceed as follows:

(1) Open torch acetylene gas valve and immediately ignite the gas by using a friction lighter. Don't use matches or cigarette lighters for this purpose (See **Figure 3-12**).

(2) Adjust the acetylene valve for a proper flow of gas. The flame should stand 3/4" away from the tip before it starts to flare out. If too much gas is used the flame will blow away from the tip; if too little is used the flame will snap back or backfire. Never open the oxygen valve until the acetylene is lighted.

(3) Open the torch oxygen valve until a small blue cone forms within the flame.

(4) With a cutting torch, open the cutting-oxygen valve momentarily and readjust the oxygen preheat valve if necessary to obtain the proper flame. The equipment is now ready for use.

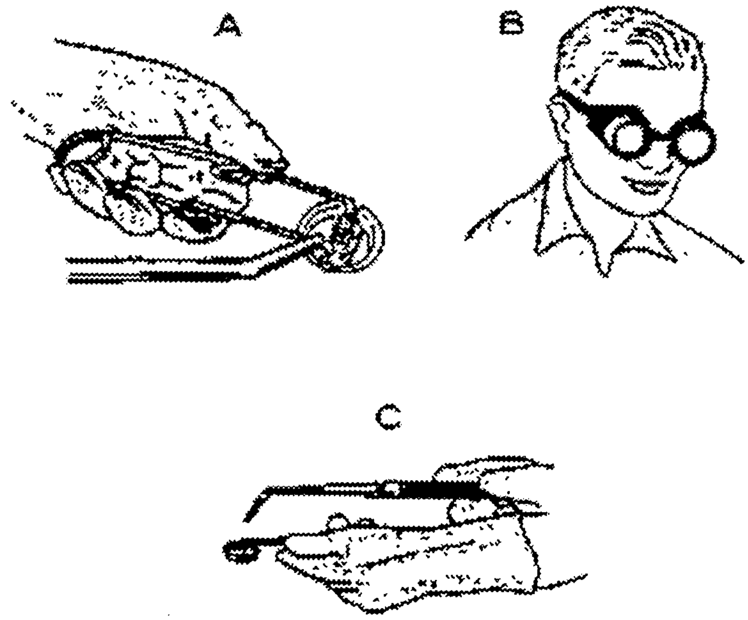
c. To adjust the flame do the following.

(1) After the torch is lit, to produce the pure acetylene flame, adjust the acetylene needle valve until sufficient acetylene emerges to form a gap of about 1/8-inch between the tip and the flame. The oxygen needle valve is then opened and adjusted until the flame burns with the proper characteristic.

(2) The neutral or balanced flame is achieved by mixing 1 part oxygen to 1 part acetylene. It is a clearly defined flame readily obtained with a little practice. It is composed of two distinct parts: the inner core and the outer envelope. The inner core is a brilliant white cone from 1/16-inch to 3/4-inch long. The outer envelope, or sheath flame, is only faintly luminous, with a bluish color. When the flame is on the carbonizing (excessive acetylene) side, whitish streamers of unburned acetylene are seen leaving the inner cone and entering the sheath flame. As the acetylene supply is decreased, these streamers decrease in length until there remains only the sharply defined inner cone and the neutral oxyacetylene flame has been found. The final adjustment of a neutral flame is made by starting with an excess of acetylene and reducing it to achieve the desired effect.

(3) The carbonizing flame has a higher ratio of acetylene to oxygen than the neutral flame. The oxidizing flame has a higher ratio of oxygen to acetylene. It is identified by a harsh sound, with the inner cone appearing shorter and less sharply defined.

(4) Setting the proper flame is of great importance to the operator, as without it no amount of skill will accomplish a satisfactory job.



A-TORCH LIGHTER B-WELDING GOGGLES C-LIGHTING PROCEDURE

Fig. 3-12 Lighting the torch

(5) Oxyacetylene welding in aids to navigation work aboard tenders is generally confined to brazing tubing connections where a slightly oxidized flame is used. However, oxyacetylene apparatus is mostly used for cutting chain and heating shackles aboard tenders. For this purpose, a neutral flame is best.

d. To shut off the torch when finished with the equipment, proceed as follows:

(1) Extinguish the flame by first closing the acetylene valve, then the oxygen needle valve on the torch. Closing the acetylene valve first is extremely important.

(2) When welding or cutting work is stopped for more than one-half hour, close the cylinder or pipeline valves and open the torch valves to release the pressure in the hose. Release both pressure adjusting screws on the regulators.

(3) When work is completed for the day, make certain that all cylinder valves are closed and all gas pressures between the cylinders and the torch are released. It is good practice to disconnect the hose, torch and regulators, placing them in storage and replacing the protection cap on the cylinders. If the regulators are left attached to the cylinders, always release the pressure on the diaphragm by turning the adjusting handle several turns to the left. Protect the regulators with a canvas cover.

14. Cutting and Heating Procedures.

a. Cutting procedures are as follows.

(1) In most cases cuts are started at the edge of the piece. The torch is held lightly but steadily with one hand supporting it a few inches back of the cutting head. The other hand is on the handle, capable of operating the cutting flow trigger or level. Hold the torch so that the ends of the preheating flame cones are about 1/16-inch above the surface of the material. When a spot of metal at the top edge has been heated to bright red, press the trigger or lever controlling the cutting oxygen flow and begin cutting (See **Figure 3-13**.)

(2) The torch must be held at the proper height above the work. It is then advanced slowly along the line of cut, making sure that the slag or oxide flows freely and cleanly through the metal. If cutting a metal other than low carbon steel, a different cutting pattern may be required. If the torch is moved too fast, the advancing metal will not have time to preheat properly, and will not flow. The torch must be moved just fast enough to allow oxidation to take place through the material as the cut progresses. The operator should look down into the cut as it progresses and watch the drag, or amount which the cut curves backward in a direction opposite of the travel. If the torch head wavers from side to side, a wider kerf will be made, the speed will be reduced, and oxygen consumption increased. If the

torch is moved along the line of cut at an irregular speed, the cutting will be slowed down and the gas consumption increased.

(3) A common error is cutting the flow of oxygen before the metal is properly preheated. Another error is not allowing the preheating flame to run down over the side of the edge of metal when the cut is begun, as well as heating the top.

b. When burning a hole in metal, or starting a cut away from the edge, more time is used in bringing the spot of metal to the kindling temperature than when starting at the edge. After the spot is sufficiently heated, the torch is raised one-half inch above the normal cutting position and the oxygen flow is turned on slowly.

(1) As soon as the metal is perforated, the torch is again lowered to the normal height above the work and the cut is completed. In piercing holes, do not allow slag to plug the cutting orifice (See **Figure 3-14**.)

c. When cutting cast iron, intense preheating is necessary, requiring larger cutting tips than usual. The preheating flame should be adjusted so the length of the streamer is equal to the thickness of the cut. Hold the torch farther away from the metal than when cutting steel.

d. The quality of an oxyacetylene cut is judged by the shape and length of the draglines, the smoothness of the sides, the sharpness of the top edges, and the amount of slag adhering to the metal.

(1) Draglines are the line markings which show on the cut surfaces. Good draglines are almost straight up and down., whereas poor draglines are long and irregular or excessively curved. If the draglines are short and almost vertical, the other characteristics are almost sure to be satisfactory.

(2) A satisfactory oxyacetylene cut shows smooth sides. A grooved, fluted, or ragged cut surface indicates a cut of poor quality.

(3) The top edges resulting from an oxyacetylene cut should be sharp and square. Rounded top edges are not considered satisfactory. Melting down of the top edges may result from incorrect preheating procedures or from moving the torch too slowly.

(4) An oxyacetylene cut is unsatisfactory if slag adheres so tightly to the metal that it is difficult to remove.

e. When heating a rivet pin shackle (heat and beat), follow these steps.

(1) The pins must be heated to a high red heat for optimum strength in the finished rivet.

(2) A neutral flame from a fairly large tip is necessary. (The rose bud tip is recommended.)

(3) Play the flame over the end of the pin to maintain a uniform temperature in the part of the pin to be peened. When the cupped end of the pin is a bright red, it is ready for peening.

CUTTING TECHNIQUES

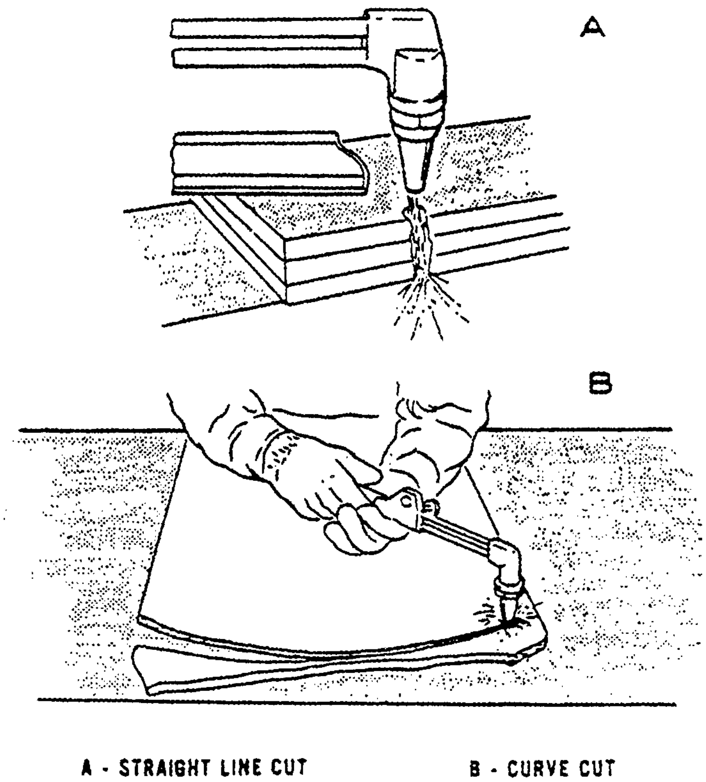


Fig. 3-13 Cutting with a torch

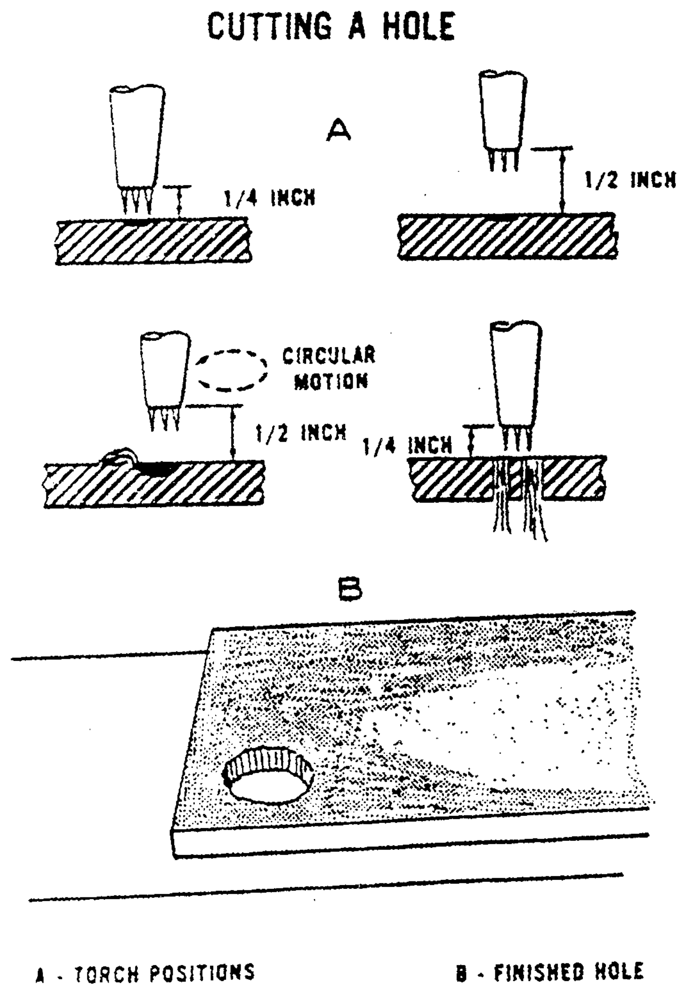


Fig. 3-14 Hole burning

15. Safety and Troubleshooting Review.

a. Safety.

(1) If the regulator creeps (pressure rises when torch valve is closed) more than 10 psi, the regulator is defective and should be replaced.

(2) Do not use the torch as a hammer, crowbar, or wedge.

(3) Do not hang the torch and hose on regulator cylinder valves.

(4) Use the proper wrench when changing tips or inspecting the torch.

(5) Remove dirt from cutting and brazing tips by using the proper size tip cleaner.

(6) Never cut on a concrete sinker. Parts of the sinker may explode when heated.

b. Trouble Shooting.

(1) If the orifices of welding or cutting tips become obstructed, clear them by using a tip cleaning tool of the proper size. A piece of soft copper wire may be used if a proper tip cleaner is not available. Clean the orifices from the inside whenever possible. Avoid the use of sharp hand tools which would enlarge or flare the orifices. Enlarged orifices affect torch performance.

(2) If leakage develops around the torch valve stems, tighten the packing nuts. If this does not stop the leak, have the valves repacked.

(3) Excessive pressure caused by opening the cylinder valve too quickly may damage the pressure regulator gauges. This is indicated when the pointer will not turn to zero. Such gauges should be returned to the manufacturer for repairs.

(4) When regulators are to be left out of service for several days or longer, adjust the tension on the regulator screw. This relieves the pressure on the valve seat and lengthens its life.

(5) If the torch gas adjusting valves turn too easily, allowing the flame to be continually knocked out of adjustment, or if gas leaks past the valve stem, tighten the packing nut or install new packing in the gland or nut threads.

(6) If the needle valve does not shut off completely, remove the valve assembly and wipe seat and plug with a soft clean rag. If the leak continues, replace the worn parts with the new ones ordered from the original manufacturer of the torch.

(7) When changing heads, tips, or extension, make sure that all seating surfaces are clean. A loose connection or a piece of dirt on the tip seat may cause backfire or even flashback. When tightening, use only enough force to make a gas-tight fit.

CHAPTER 4: BOOM/CRANES/WINCHES AND OPERATOR QUALIFICATIONS

A. Capstans and Windlasses.

1. General. The importance of good line hauling gear for handling buoys cannot be overemphasized. The handling of large buoys without the restraint of cross-deck or cage lines is poor seamanship and is dangerous to the ship and crew.

2. WLB. The 180-foot class tenders have a horizontal anchor windlass located on the forecastle deck. This consists of two wildcats for the anchor chains, two gypsy heads, and a drum originally intended for use with the deep-sea anchor cable. The windlass is driven by an electric motor. Fair-lead roller-type chocks are placed on the aft section of the forecastle deck to provide a suitable lead for the crossdeck line from the buoy deck. When leading a line to the gypsy head, take care to insure that over-riding turns do not occur. Additionally, the locking nuts and studs of the wildcat clutches may break off if they are permitted to work loose, and the windlass is engaged. There is a tendency to forget to tighten them after clutching the wildcats in or out. There is very little clearance between these nuts and the foundation when the windlass is rotating. Included on the major-renovated WLBs are hydraulic powered, wire rope crossdeck winches. These are located in the aft corners of the buoy deck.

3. WLM.

   a. The 157-foot class tenders have two independent, vertical anchor windlasses located on the forecastle deck. Each consists of a wildcat for the anchor chain and a gypsy head for line handling. The windlasses are each driven by a two speed reversible electric motor. The motor controls are on the forecastle deck. The clutches are located under the forecastle and cannot be engaged from the forecastle deck. The gypsy heads do not lend themselves well to leading lines from the buoy deck. However, in each corner of the buoy deck is a hydraulic cross deck winch. Cross deck ropes from these winches can be led to almost any point on the 157-footer's buoy deck.

   b. The 133-foot class tenders have a large combination, vertical anchor windlass and capstan on the forecastle. This system controls a buoy by leading a line from the forecastle to a snatch block on deck and then to the buoy. The capstan has a very large diameter and is awkward to for one person to take turns on. Some tenders have hydraulic, pneumatic or electric deck winches located port and starboard aft on the forecastle deck. The winches are used to assist in crossdeck and chain hogging procedures.

4. Barges.

   a. The Second District barges have a pneumatic capstan located amidships at the buoy ports. The mooring cable is led around this capstan and it is used to raise the sinker. The river tender tugs and barges have spud winches to raise and lower the spuds.

b. The 120-foot AtoN Barges have four hydraulically powered gypsy head winches positioned fore and aft of each buoy port. The four winches can be controlled individually either from a control station located amidships, just aft of the deck crane, or by using manual hydraulic controls located at each winch. On the barge forecastle is a hydraulic anchor winch with 500 feet of 1" diameter 6 x 37 steel wire rope.

c. The construction barges are also equipped with spud winches.

5. Boats.

a. The 55-foot ANB have two hydraulic gypsyheads, one on the port and one on the starboard side. These use a synthetic line to hog buoys into the pelican hook and to moor to large buoys. On some units the gypsyheads have been replaced with a hydraulic wire rope winch.

b. The 46-foot BUSL has three hydraulic wire rope winches. One is on each side of the A frame to act as the hoisters and one is on the port side at the forward end of the buoy deck to control the crossdeck. These winches are all controlled from the main control panel.

c. The 45-foot BU has two hydraulic wire rope winches. One is located on the port side under the pilothouse and fair led to the A frame and acts as the hoister. The other is located amidships under the pilothouse and acts as the crossdeck. Both are controlled from inside the pilothouse.

B. Hoisting Machinery.

1. General. Hoisting Machinery on tender class vessels falls into three main categories: electric, pneumatic, and hydraulic. Most small tenders have pneumatically driven hoists. Most buoy boats obtain their hoisting power from electrically driven hydraulic pumps. The 157-foot, 133-foot, renovated (Major and SLEP) 180-foot tenders and 120-foot AtoN barges have hydraulically powered hoisting equipment.

2. Weekly Inspection. All machinery should be carefully inspected weekly, and necessary routine maintenance performed. Most machinery is listed on Preventive Maintenance System Cards (PMS). The PMS Cards are the best indicator of routine maintenance requirements. Brakes should be adjusted as necessary. Pneumatic and hydraulic systems should be checked for leakage of air or hydraulic fluid, especially at joints or elbows. The inspections and tests for electric-driven hoisting equipment shall include resistance tests of all circuits and inspection of motors and electrical connections. Control equipment should be thoroughly inspected and electrical contacts checked for proper tension and arcing. Megger readings for the electric hoisting motors shall be entered on the machinery history cards. All watertight motors and controllers should be checked for collection of water due to condensation or leakage. Most of these units have drain plugs, but if these are not provided, a bolt or screw, permitting drainage, should be removed. If possible, a dry day should be chosen for this test. If the air is dry, it may be desirable to remove inspection plates to permit air to circulate through the equipment. If water is found, it should be ascertained whether it is fresh or salt, and appropriate action taken. The collection of

a small amount of condensation in these units under some climatic conditions is not uncommon. However, maintenance of the air and water seals will reduce this effect to a minimum.

3. Annual Inspection. Complete inspection and overhauls of all hoisting machinery shall be made in accordance with the Naval Engineering Manual, COMDTINST M9000.6 (series). Parts subject to extensive wear and deterioration should be inspected and overhauled as required. During these inspections all moving parts shall be thoroughly inspected, lubricated and if necessary, replaced.

4. Other Electric Hoists. Several of the smaller inland tenders have electric hoist motors. These smaller motors have a line pull of 1,000 pounds at 58 feet per minute.

5. Compressed Air Hoists. Some inland tenders have air motor hoists. These have a line speed of 55 feet per minute at 2,000 pounds single line load (Sullivan type E112). Air-driven hoisting machinery is very powerful for its size and weight. It is flexible in that it will back up in case of an overload and can be thrown out of gear to permit placing buoys in the water. This feature, not available in electric installations, is very advantageous when working buoys.

C. Booms and Rigging.

1. General.

   a. There are several types of booms and rigging in use on aids to navigation tenders. No attempt will be made to cover each type comprehensively; however, representative samples will be described and discussed below. A discussion of weight handling equipment, their capacities and inspection procedures can be found in Chapter 573, COMDTINST M9000.6 (series).

   b. All tenders with fore and aft booms should cradle the boom and secure it with a cradle strap when underway and not servicing aids. This will prevent the boom from raising up and jerking downward when the ship is rolling or pitching. If it is not feasible to cradle the boom because of a deck load or short periods between use, a preventer must be rigged to prevent the boom from swinging free. The preferred method to rig a preventer is to secure the whip to the nearest deck padeye using a short sling with an eye in each end. Rigging a preventer may prevent catastrophic damage to the boom, when the boom is moved past its toppling point. The 180-foot tenders have a boom with two separate topping lifts suspended from opposite reinforced corners of the bridge superstructure. Should the vessel be hooked to a load such as a buoy over the side, and a sudden strain from an astern direction be put on the boom, it will rise up in the air, one topping lift becoming slack, with the possibility that the boom may jackknife back over the bridge. Therefore, whenever a strain in an astern direction or heavy rolls are anticipated, one of the hoisting tackles should be hooked into a padeye in the deck as a preventer. In the design of the boom, provision was made for rigging a single vang or preventer tackle leading from a point near the end of the boom. This may be used instead of hooking a power tackle into the deck. **CAUTION: When taking up on the sling with the whip or main, remember the lifting**

capacity of the boom winch and wire exceeds the breaking strength of the double ended sling.

c. The 180-foot tenders are the most numerous class of tender with the 75-foot and 65-foot river tenders (with their barges) the next most numerous.

2. WLB-180 (SLEP) and Major Renovated Buoy Tenders. These tenders have a 50-foot tubular boom and reinforced bridge structure. They are designed for normal hook load of 40,000 pounds with the boom at an elevation of 45 degrees. Two hoisting motors are located near the bridge supports and are connected to operate the vangs which control elevating and rotating the boom. Two other hoisters are located on the boom for operating the two lifting purchases. The upper purchase is rigged as single whip with a capacity of 10,000 pounds. The lower purchase may be rigged as 3- or 5-part tackle. When rigged in 5 parts, it has a capacity of 40,000 pounds at 16 feet per minute. It is intended that the lifting purchases be rigged for 3 parts when handling the larger lighted buoys up to and including the 9-foot type. The topping lifts are 7-part purchases.

a. The wire rope lengths are:

(1) Main Purchase: Maximum wire on the drum is 3 layers (when two blocked). Minimum wire during operation is 5 wraps when fully extended and hook is at the extreme lower position. If meeting the minimum criteria of 5 wraps results in more than 3 layers when two blocked contact your MLC type desk.

(2) Whip: Total wire length is 200 feet. Minimum wire on the drum during operation is 5 wraps when the hook is at the extreme lower operating position.

(3) Vangs: Total wire length is 400 feet. Minimum wire on the drum during operation is no less than 5 full wraps, when the boom is fully lowered and slewed outboard to its maximum outboard safe working reach.

b. The controls for the SLEP and MAJREN are similar, consisting of a joystick for controlling the boom and one lever each for raising and lowering the main and whip. Some tenders have an auxiliary hoister of 350-pound capacity which has its own lever. The MAJRENs have wire crossdecks also controlled from the boom shack, each having its own lever for controlling inhaul/outhaul. These controls actuate air controllers for the hydraulic winches.

c. The Austere Renovated WLBs retain the original electric motors. As there are only three remaining at this writing and they are scheduled for decommissioning, their systems will not be addressed here.

3. Hydraulic Hoisting Gear on 157-Foot Tenders. This gear is controlled from boom control rooms located under the bridge wings on either side of the ship. It is a three-lever control. One lever operates the slewing and topping gear, one the main hoist, one the relief (whip). There are no wire vangs. The boom is slewed rapidly by a bull gear at the base of the king post. The king post turns with the boom when slewing.

The topping lift wire and the main hoist are fair led from the top through the hollow king post, down into the main hold where the hoister winches are located. The slewing gear is driven by a hydraulic motor, as are all drums for the topping lift, main, and relief. They are variable speed motors, with the boom operator controlling the rate of oil flow which controls the motor speed. The relief (whip) winch is located on top of the boom aft near the king post. There is a constant tension feature built into the whip. This is to be used with the snubbing winches located aft on the king post. This gear is designed to keep a load from swinging when the ship is in a seaway. The main is a 3-part purchase and can lift 10 tons; the single whip can lift 4 tons.

4. Hydraulic Hoisting Gear on 133-Foot Tenders.

   a. A Diesel engine drives two hydraulic pumps via a power take-off. The engine and pumps are located in the engine room. Engine speed control is accomplished pneumatically from the remote speed control platform located forward of the pilot house.

   b. The control console houses the four pneumatic controls: one for the topping winch, one for the main purchase, one for the relief (whip) purchase, and one for the slew gear. The console also houses hydraulic pressure gauges to monitor system pressure and electrical controls to operate the hogging winches.

   c. The 133-foot tenders have a 38-foot twin vee tubular boom the pivots vertically on two boom foot pins. This configuration is controlled by three identical single drum winches. Each is designed to carry 200 feet of 3/4" diameter wire rope. All three winches are under wound with 3/4' 6X37 IWRC, XIPS wire rope. Each winch is operated by its own hydraulic motor. The main purchase winch is located on the boom. The main purchase is a 2:1 gun tackle with a safe working load of 20,000 pounds. The topping and relief purchase winches are located in the winch room and are fair led up to the boom. The secondary purchase (whip) is a single lead with a safe working load of 8,000 pounds. The topping purchase is a single luff tackle rigged with the single block secured to the top of the A-frame above the flying bridge.

   d. The slewing gear is operated by a hydraulic motor and is located in the winch room. Rotation is transferred to the boom by a five-inch pinion gear shaft. This shaft and keyway are the weak link in the rig when the boom is side loaded. Heavy side loading should be avoided.

5. Cranes on 75', 100' and 160' Construction and all River Tenders. Several types of cranes are used on barges of the pusher/barge, and 160-foot WLIC tenders:

   a. The river tender barges have either Appleton, Allied or Alaska hydraulic articulating cranes. These cranes slew, elevate, hoist and have a jib that allows them to bend like an arm. They are rated for loads of between two and three tons. The crane operator is seated at a control console mounted on and rotating with the base of the crane.

   b. Construction tenders which operate along the Intracoastal Waterway have an enclosed cab, pedestal mounted lattice boom CG 300 crane. Long reach cranes of this type are needed on the Intracoastal Waterway to work with pile driving equipment.

c. When working with pile driving equipment, if corrective procedures are needed, the hammer and the lead shall be placed in the cradle. All routine maintenance should be carried out with the hammer and the lead in the cradle. Climbing a lead is dangerous and should not be done. The time required to lower the lead is time well spent from a safety standpoint. Should the gantry hydraulics fail, the load can be released on these cranes using a porta-power.

6. Hydraulic Cranes on the WTGB 120-foot AtoN Barge. Some of the 140-foot Icebreaking Tugs push a 120-foot AtoN barge to perform the aids to navigation mission. These barges have an Appleton Marine hydraulic powered telescoping pedestal crane that is capable of lifting 40,000 pounds on its main purchase at a radius of 55 feet. When the crane is telescoped to a radius of 75 feet, the single part purchase can hoist up to 10,000 pounds. The crane is designed to withstand horizontal sideloads equivalent to half of its lifting capacity. The recommended wire used is either 6 X 25 or 6 X 37 RRLFW. Dioform 18 rope is authorized for installation on only the main purchase on both barges.

7. Hoisting Gear on the 100-Foot Construction and Inland Tenders.

a. The RAMBLER, PRIMROSE, SMILAX, and BLUEBELL have a 27-foot tubular boom equipped with five-part main and single ship hoisting tackle using 7/16-inch wire rope. The working capacity is 10,000 pounds rigged for five part, 6,000 pounds rigged for three part and 2,000 pounds at 60 feet per minute for the whip. The hoister comprises three individual single drum clutch and contracting brake type winches driven by compressed air motors developing 2,000 pounds line pull at 60 feet per minute. They will each withstand a static pull of 14,600 pounds. The whip, located on the end of the boom, uses 65 feet of wire, the main, 170 feet, the topping lift, 140 feet of wire. The blocks are 10-inch steel double sheave type. Many of the inland waterways-type tenders use a stubby kingpost instead of the conventional-type mast for supporting the boom.

b. In addition RAMBLER and SMILAX push a construction barge equipped with a Weatherford CG-300 crane. Maximum lift capacity of this crane is 18,000 pounds.

c. BUCKTHORN has an Appleton hydraulic telescoping crane rigged with 1/2" wire rope on the main and having a 10,000 pound capacity with a two part. The whip is rigged with 3/8" wire rope and has a capacity of 3,000 pounds.

8. Hoisting Gear on the 65-Foot Inland Tenders.

a. ELDERBERRY has a hydraulic crane and has a lift capacity of 4,000 lbs.

b. BAYBERRY, CHOKEBERRY, BLACKBERRY have pneumatic topping lifts and hand powered vangs with a lift capacity of 4,000 lbs.

c. In addition, BAYBERRY's hull has been modified to accommodate a 60' ATON barge. This barge is equipped with a hydraulic crane capable of hoisting 4,000 lbs.

9. The 55-Foot (ANB) Aids to Navigation Boat. There are three different types of cranes on the 55-foot ANB. The vessels with the M45 Huskey crane (installed on boats 55101 - 55112) are limited to 2,000 pounds safe working load up to 13' reach and 1,000 pounds beyond 13'. The second group of vessels with the M45 Huskey crane (boats 55113 - 55119) have a safe working load of 3,000 pounds up to 13-foot reach and 2,000 pounds beyond 13 feet. The last group (boats 55120 - 55122) have a 3,300 pound lifting capacity. The cargo capacity of all 55-foot ANBs is 4,000 pounds. Note: (1) Maximum safe working loads are calculated for each class over the stern "notch." (2) All three crane types are scheduled to be replaced with an Alaskan Model 4-20 crane.

10. The 46-Foot (BUSL) Buoy Boat; Stern Loading. There are two classes of BUSLs. The first class, boats 46300-46306, can lift a maximum of 3,000 pounds. Boats 46307-46315 are rigged with 3/8" wire and have a maximum capacity of 4000 pounds. The buoy handling equipment on these craft consists of a stern mounted A-frame, the top of which can move fore and aft, hoisting winches mounted on each side of the top of the A-frame, a deck winch, and a chain stopper. Except for the chain stopper, all of this equipment is hydraulically powered. Hydraulic rams attached to the base of the A-frame power its fore and aft movements within the rated winch capacity.

11. The 45-Foot (BU) Buoy Boat; Bow Loading. All of the 45-foot BUs are rigged with 5/8" wire rope with a safe working load of 4000 pounds. The buoy handling equipment consists of a bow mounted A frame driven by two hydraulic rams, two hydraulic underwound winches (one for the main purchase and one for a cross deck) and a manually operated chain stop.

D. Rigging Inspection and Maintenance.

1. Daily Inspections and Lubrication. The primary purpose of the daily inspection of rigging is to make certain that the equipment is safe for use. At the beginning of each work day, a visual inspection shall be made of all the rigging. The padeyes and hooks shall be examined at close range, a careful search being made for any cracks that might have developed. The hook shall always be examined immediately before lifting a full-rated load. The lubrication of boom seats, and the pins and blocks in the rigging should be a daily task when the equipment is in use. If properly accomplished, these lubrications, will increase the life of the equipment. Wire rope should be lubricated as needed, and in all cases should be slushed adequately to prevent rusting when not in use.

   Caution--The hoisting tackle and hook should never be tested by jerking on the weight. While this method might expose a failure on a part of the gear, it may also start a failure which does not become evident at the time. Complete failure may then occur during actual operations with possibly disastrous results.

2. Weekly Inspections. The weekly inspection of rigging shall be more thorough than time will normally permit for the daily inspection. Routine maintenance, necessary for keeping equipment in good condition, should be performed now. The weekly

inspection shall include the following: All fiber and wire rope, padeyes, hooks, booms, and other fittings, shall be carefully inspected for accumulated wear and distortion. Wire rope shall be cleaned and lubricated as needed, and renewed if required. Examine the interior of all fiber line for mildew and indications of deterioration. The amount of weathering, wear, and elongation permissible before replacement depends upon the use. Line should not be discarded needlessly, and when no longer suitable for one usage, should, if practical, be shifted to a less severe one.

3. Annual Inspections. A complete inspection of the boom and all running rigging of all SRA vessels shall be made in accordance with COMDTINST M9000.6 (series), at least once each year. Parts subject to extensive wear and deterioration should be inspected and repaired as required. It is intended that during these inspections, all moving parts shall be thoroughly inspected, and where applicable, lubricated. The inspection period should follow a period of dry weather, to insure that the least possible amount of moisture is present in the wire rope.

4. Biennial Overhaul. Every other year, normally during the vessel's dry-dock availability, and concurrently with the Annual Inspection, the biennial overhaul of the boom will be accomplished in accordance with COMDTINST M9000.6 (series).

5. Unauthorized Alterations and Procedures. There is an occasional tendency among operating personnel to attempt to modify or alter hoisting rigs from the designed standards to suit their own concept of operational need. The placement of various connections on a boom and the size of the tackles has been carefully considered by the designer to minimize the strains involved. A slight alteration may unknowingly weaken the boom to a dangerous extent. Any departure from the intention of the designer, either through alteration of the boom structure or rigging, or unorthodox operation, is not authorized. Authorized alterations are listed in Chapter 573 of the Naval Engineering Manual. The following rules should be observed to avoid dangerous operation of any cargo boom:

   a. Do not handle any hook loads above the rated capacity of purchase except test loads.

   b. Do not alter the location or details of the boom fittings or install jury rigs of any kind.

   c. Do not reduce the number of parts in the topping lift, or the size and quality of standing or running rigging. It is sometimes advantageous to reduce the number of parts in the lifting purchases to gain greater speed, but capacity must be proportionally reduced.

E. Padeyes.

1. Inspection and Replacement.

   a. Inspection of padeyes and associated links should be a part of the inspections routinely made of all buoy handling gear.

   b. Many of the older tenders have ring-type padeyes which, when overloaded, will elongate and take a permanent set. Padeyes in this condition should be replaced by installing links of proper size.

c. Some units have ordered replacements in the past without reference to technical information. This resulted in their recommending stock sizes of rings involving an actual reduction of strength for the fitting. In ordering material of this nature, specifications should always be stipulated, rather than mere reference to physical dimensions or stock numbers.

d. Any changes, additions, or deletions of padeyes are to be carried out in accordance with applicable drawings for the vessel type and class. This is to prevent installation of padeyes where the deck is not capable of holding the load and to prevent each succeeding command from placing padeyes as personal preference dictates. Padeyes have to be tested in accordance with COMDTINST M9000.6 (series) Naval Engineering Manual with the unit or district funding the test from AFC-30 funds.

F. Crane and Boom Qualifications.

1. Operations. Operations shall be directed only by the individual specifically designated for that purpose.

2. General Qualifications for Deck Supervisor.

    a. Personnel in charge of operations shall be qualified crane or boom operators. This certification shall be in writing. Confirming the successful completion of applicable 16500 (series) PQS.

    b. Personnel in charge shall know and use the standard hand signals illustrated in **Figure 4-1**.

3. Practices of Deck Supervisor.

    a. The Deck Supervisor shall not engage in any practice which will divert his attention while actually directing operations.

    b. The Deck Supervisor shall not direct operations when mentally or physically unfit.

    c. The Deck Supervisor shall only give signals to the boom operator or appointed signalman.

    d. The Deck Supervisor shall be held directly responsible for the safe operation of equipment under his direction. **Whenever there is doubt as to safety, he shall refuse to authorize operations until safety has been assured**.

    e. Before permitting equipment to be left unattended, the Deck Supervisor shall direct disposition of all loads and make certain equipment is secured.

    f. If power fails during operations, the Deck Supervisor shall investigate and take necessary action before operation is resumed.

    g. The Deck Supervisor shall visually inspect the rig and all associated weight handling equipment before each use.

    h. The Deck Supervisor shall make use of tag lines and other devices to control the load.

i. The Deck Supervisor shall keep side loads at a minimum and shall direct operations in such a manner to keep lifts as vertical as possible.

j. The Deck Supervisor shall lift loads only as high as necessary to clear obstacles, except that buoy chain shall be pulled to maximum safe lifting height for retrieval.

k. The Deck Supervisor shall carry out an operation only after the safety of all personnel on deck is assured.

l. The Deck Supervisor shall know what the emergency release procedure is for the crane or boom.

4. Operators.

a. Cranes and booms shall be operated only by designated operators or trainees under the direct supervision of designated operators.

b. No one other than operators, trainees, maintenance personnel or maintenance supervisors shall enter a crane or boom operating enclosure.

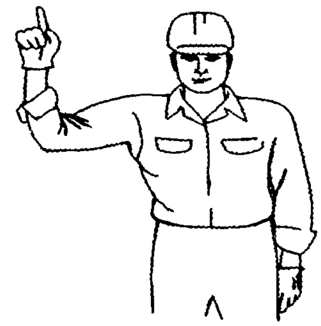
5. Qualifications of Operators. The variations in crane and boom types on Coast Guard vessels makes it difficult to address every type. However, general qualification guidelines are possible. Listed below are the general requirements which shall be used to develop a formal qualification program for crane and boom operators on every unit.

a. All operators shall be designated in writing by the Commanding Officer or Officer In Charge.

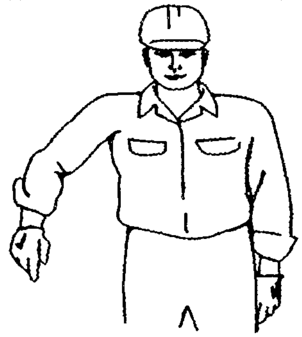
b. Operators shall know and use the standard hand signals contained in **Figure 4-1**.

c. Operators shall complete PQS per COMDTINST M3502.4 (series).

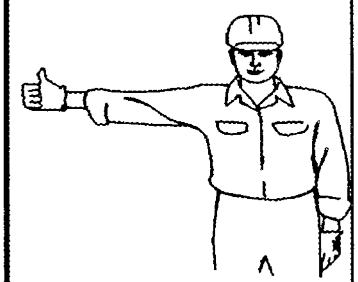
Use Standard Hand Signals - Confusion Causes Accidents



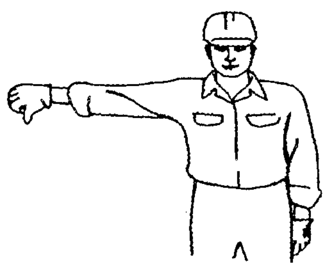
HOIST LOAD
With forearm vertical, forefinger pointing up.



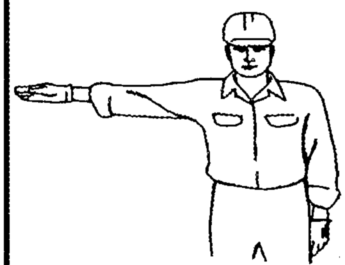
LOWER LOAD
With arm extended, forefinger pointing downward.



RAISE BOOM
Arm extended, fingers closed, thumb pointing upward.

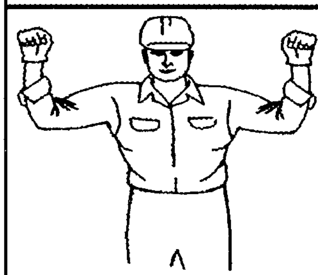


LOWER BOOM
Arm extended, fingers closed, thumb pointing downward.

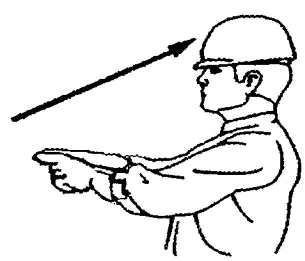


SLEW BOOM
Arm extended, point with fingers in the direction of the slewing boom.

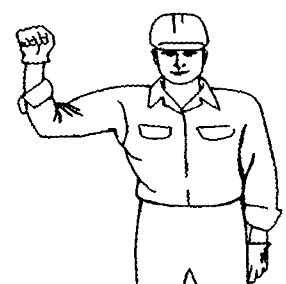
DOG EVERYTHING
Clasp hands in from of body. (Set the brakes, place crane controls in neutral; load handling temporarily secured)



EMERGENCY STOP
Arms bent upward, fists clenched. This signal stops all crane motion in progress.



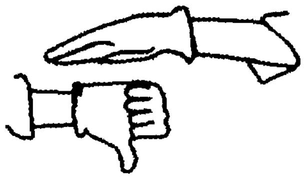
DECK SUPERVISOR TRANSFER
Tap sides of helmet with fist, then point to new Supervisor; repeat.



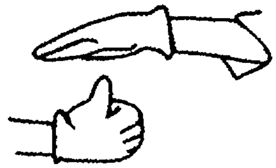
STOP
Arms bent upward, fists clenched. When giving independent signals with each arm, a clenched fist on that shall be used to stop the respective crane motion.

WLB & WLM - One finger is used to direct the whip. Two fingers are used to direct the main purchase.

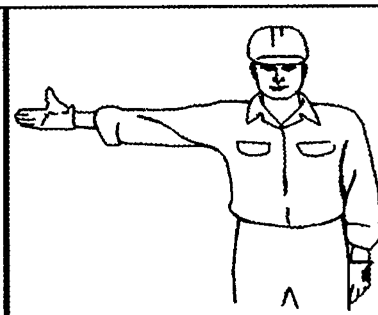
WLB - With electric winch motors, use ONE, TWO, or THREE fingers to indicate winch speed desired. Also the signals pictured for Main Hoist and Auxiliary Hoist.



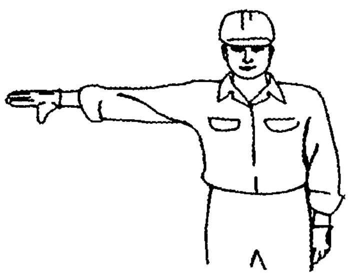
LOWER
KEEP L
Use one hand to give any motion signal and place the other hand motionless over or under the hand giving the motion signal.



RAISE BOOM AND KEEP LOAD LEVEL
Use one hand to give any motion signal and place the other hand motionless over or under the hand giving the motion signal.



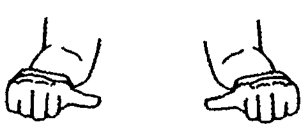
RAISE BOOM AND SLEW THE LOAD
With arm extended, thumb pointing up. Fingers out as long as load movement is desired.



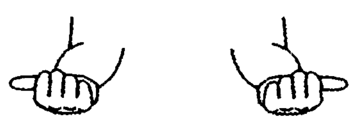
LOWER BOOM AND SLEW THE LOAD
With arm extended, thumb pointing down. Fingers out as long as load movement is desired.

USE MAIN HOIST
Tap fist on head, then use regular hand signals to hoist or lower.

USE AUXILIARY HOIST
Tap elbow one hand, use regular signals to hoist or lower.



RETRACT BOOM
(Telescoping Booms)
Both fists in front of body with thumbs pointing inward.



RETRACT BOOM
(Telescoping Booms)
Both fists in front of body with thumbs pointing outward.

WLC - ONE, TWO, or THREE fingers are used to indicate the purchase you are using. Purchases are numbered according to the arrangement of winches in the gantry.

In some cases there may be the need for special signals not covered in the signal chart. In these cases, special signals must be agreed upon in advance by the operator and the deck supervisor. These special signals must not conflict with or have the potential to be confused with the standard signals.

CHAPTER 5: SHIPHANDLING AND BOATHANDLING

A. General.

1. Purpose. This chapter discusses the fundamental principles involved in maneuvering single and twin screw vessels. The purpose is **NOT** to discuss in detail every potential maneuvering situation or to prescribe a correct way to approach a given shiphandling evolution. It is important to note that shiphandling, in the broadest sense, covers the maneuvering spectrum from being Dead in the Water (DIW) to full speed ahead. In this chapter we will limit the discussion to the lower, slower end of that spectrum. Since there are numerous publications written on the science of shiphandling (and many incorporate examples from the most experienced masters), it is recommended that all cutters obtain a cross section of these and incorporate them into their training programs. *Naval Shiphandling* and *Knight's Modern Seamanship* are both good reference books.

2. Shiphandling in AtoN Work. Shiphandling, especially in aids to navigation work, is an art learned by constant study, analysis, experiment, and practice (in short, experience). For a conning officer to develop, he/she must first possess an understanding of the fundamental effects of a ship's rudder, propeller(s), and general characteristics on the marine environment and apply that to his/her experiences. Good shiphandling is essential in aids to navigation work from the standpoints of safety and operational efficiency. When setting or retrieving buoys, one is often required to put a ship in places where no prudent seaman would voluntarily go. Constant vigilance is the watchword when working aids to navigation. The slightest inattention on the part of the shiphandler when a buoy is alongside or being hoisted can easily and immediately cause damage to the ship or injury to the crew.

3. Providing Development Opportunities. It is essential that Officers-In-Charge and Commanding Officers provide ample shiphandling opportunities for junior personnel. This should include a review of the evolution so errors in planned procedures can be worked out before hand. During the early stages of skill development, the conning officer should plot out all actions ahead of time, using vector diagrams. They can be sketched out quickly, until experience allows him/her to picture the situation. It is helpful to use these diagrams both to analyze shiphandling evolutions of other conning officers and to rehearse recurring situations that your vessel often finds itself in. Wardroom chalk talks and constructive critiques after shiphandling evaluations are valuable teaching tools.

B. Shiphandling Hints.

1. Principal Factors. The principal factors involved with the handling of a ship are the length, displacement, draft, speed (power), depth of water, force and direction of the wind and current, space available for maneuvering, and the effect of rudder and engines. Although buoy tenders may be either single or twin screw, the basic principles involving each are similar. In most instances, these principles may be

described for large vessels, but they apply to smaller tenders as well.

2. Proper Watch Atmosphere. The conning officer must demand that the bridge is taut and quiet. There should be no excitement or confusion when conning operations are being carried out. A few quiet, well articulated commands to the helm and judicious applications of the engine are all that is needed for well-trained personnel. The conning officer should ensure the absence of frivolity or loud, boisterous behavior from the watch team. Exuberant reports to the conning officer from the watch team will raise the tension level, contribute to tunnel vision situations, and cause confusion. Particular care should be given to using standard commands. Nonstandard commands can be easily misunderstood and cause additional confusion.

3. Avoid Deception. The marine world is a dynamic, constantly changing environment. One should never expect a ship to handle exactly the same as it did the last time he/she was in the same situation. Conditions will never be exactly the same. One should always be on the alert for a sudden sheer when transiting a confined channel or approaching a dock. A quick shot full ahead or back for a short period with the engine will break the sheer and straighten the ship out, provided too much way is not on. Speed through the water is deceptive. Keep a close eye on your overboard discharge and on relative movement of objects directly on your beam. While approaching a buoy and looking solely ahead, it may appear that the ship is almost stopped. In fact, you may be contemplating giving the engine a shot ahead. As soon as the buoy gets past the bow and is coming alongside, usually, the ship is moving faster than initially thought. **Remember you can always add speed to come ahead, but you cannot always take speed off quickly enough.**

    a. Full ahead on the engine in maneuvering should not be confused with speed. Although it is desirable to maneuver the engines gently when close to a dock or a buoy, there will be times when a quick shot ahead or astern is desirable, without increasing headway. Using full rudder and two-thirds or full speed ahead for a brief interval will be much more satisfactory than prolonged use of the engine under less power. Fewer engine turns results in moving a greater distance ahead before the desired turn is achieved. This is especially true when dead in the water or moving slowly in the direction you wish to turn. It is always the strong initial thrust that has the greatest turning effect. Also, simply jamming the controller handle full ahead and then immediately bringing it to stop may not give this effect if the propeller does not have sufficient time to come up to speed. Remember, the intent is to impart a quick move to the cutter, without building up momentum. The sudden bark of the engines is not always discernible. The conning officer should pay attention to the prop wash.

    b. Another good reason for going slowly is the chance of mechanical or human failure. The pilothouse control may suddenly go dead, a circuit breaker may trip if you have moved the control too quickly, a man on deck may hold the spring line when you want it checked, etc. In any of these events, if your headway is minimal, you will probably have time to counteract what has happened.

    c. When approaching the dock or buoy, if you find that the ship has too much headway or if for any reason you feel uncomfortable with the approach, don't hesitate to back and stop. There is nothing wrong with turning around and coming in again, with a more prudent plan. Do not jeopardize the safety of the ship or crew for the sake of "pulling off" an evolution that has deteriorated. **Your pride is not worth your crew's safety.**

d. In any maneuvering situation the conning officer may direct the maneuver by ordering compass courses or by ordering rudder angles. Tight maneuvers (i.e., final approach to buoys or docks) usually dictate the use of rudder angle orders which afford greater control of the maneuver. This enhanced control factor is particularly important for the inexperienced shiphandler and/or helmsman. Compass courses should rarely be used in a final approach.

e. Finally, the conning officer should be aware that larger rudder commands are required at slow speeds to produce the desired response from the ship. Five to ten degrees of rudder may have negligible effect at slow speed.

C. Principles of Rudder and Screw Effect (Twin-screw).

1. Position of the Rudder. In steering a twin screw vessel, the position of the rudder depends upon the direction the ship is moving through the water, and not the direction in which the propellers are turning. The various forces set up by the action of a single screw balance out on twin screws, and for that reason can be disregarded. As long as both screws are working ahead or astern at the same speed, the force of water against the face of the rudder will control the steering of the ship.

2. Headway and the Rudder. When the ship has headway, and a turn to the right is desired, apply right rudder. The ship's stern will swing to port and thus change the heading of the ship to the right, or starboard. The ship pivots on a point well forward of amidship, and the stern, not the bow, swings when the rudder is put over. This swing, away from the direction to which the rudder is applied, causes the ship to change to the desired heading. Due to momentum along the ship's original course, the ship will range ahead along an arc for a ship length or two before beginning to gain ground in the desired direction. The net distance traveled on the original course is called advance. The net distance traveled laterally before steadying on the new course is transfer. To turn to the left when going ahead, apply left rudder.

3. Sternway and the Rudder. When the ship has sternway, the rudder effect is the opposite. Right rudder when the ship is going astern causes the stern to move to the right, changing the heading of the ship to port. Left rudder, vice versa. A twin-screw ship steers similarly to an automobile.

4. Effect of Screws. When both screws are turning ahead or astern at the same speed, the ship, if not influenced by external factors of wind and current and with the rudder amidships, will move straight ahead or back. If either screw is working singly, a turning moment is created which will swing the ship away from the side on which the screw is acting. For example, if the starboard screw is turning ahead alone, the ship will swing to port. If backing, then the ship's bow will turn toward the side which has the engine turning at the slower speed. The greater difference in speed, the sharper

the turn. When screws are opposed, the ship's bow will turn toward the side that is backing. Whether the ship will have headway or sternway will depend on the difference between the relative speed and power of the two engines and the amount of way that was on the ship when the operation was begun. To turn a twin-screw ship in place, the relative speed of the respective engines must be adjusted until they balance each other, discounting the effects of wind and current. In screws working opposed, remember that the screw backing must turn faster than the screw going ahead in order to balance the thrust. In turning a ship in place, it may be necessary to alternately stop and start the engine. Under some conditions, one screw backing two-thirds will about balance the other screw going ahead one third. The process of splitting the screws of a twin screw vessel and turning in place is called twisting.

5. Rudder and Screws. As stated before, the rudder is used in relation to the direction of motion of the ship through the water rather than in relation to the direction of rotation of the propellers. For example, when going ahead on both screws and it is desired to turn to starboard sharply, stop and back the starboard screw and apply full right rudder. However, when having sternway and desiring to turn the ship to starboard (stern to port), go ahead on the port engine, back on the starboard engine and full left rudder. When the ship is being swung in place with no way on, the rudder should be left amidships.

6. Steerage. When the ship is dead in the water, or nearly so, the ship lacks steerage way and the rudder will have little or no effect. This is true as the ship loses her way when coming to a stop or when starting to make way after being stopped. Control must then be accomplished with the engines until steerageway is gained.

7. Know Your Ship. The conning officer should know certain individual characteristics of his ship. For example, how much power to expect when certain speeds are ordered, how long it takes the engines to reverse, how far the ship will travel if the engines are reversed at various speeds, what effect certain degrees of rudder angle have, the diameter of the ship's turning circle, etc.

8. Standard Helm Commands. Since the standard orders to the helmsman should be familiar to all (they may be found in any standard text on seamanship and should be included in the CO's standing orders) they will not be repeated here. However, it is emphasized that only standard terminology should be employed. A confused helmsman can easily cause an accident.

D. Principles of Rudder and Screw Effect (Single-screw).

1. Propeller. In the following discussion, a right hand propeller is assumed.

2. Going ahead. The effect of the rudder is the same as described for twin-screw vessel when going ahead. Right rudder turns the ship's head to the right, left rudder to the left, and the ship pivots in a similar manner to a twin-screw vessel. Conversely, if there is no countering effect of the rudder, the sidewise thrust of the screw going ahead will swing the stern to starboard. This is more pronounced when the ship is starting to move after being dead in the water. An example of this tendency in a prolonged setting can be observed while breaking ice. The ship's head will naturally

"fall off" to port.

3. <u>Backing</u>. A different problem is involved when backing. The sidewise thrust of the backing screw has a tendency to swing the ship's stern to port. The sidewise thrust exerts the most effect at full speed astern. Additionally, the rudder has little effect until the vessel has gained considerable sternway. If the sidewise thrust of the screw to port is not too strong, the vessel may mind its helm and back "to the rudder." A single-screw vessel is more easily affected by current and wind when backing. It is a tendency of most vessels to back into the wind.

4. <u>Combinations</u>. The following are brief discussions of some possible combinations:

   a. Ship and screw going ahead. If the ship is stopped and the screw starts turning ahead, the screw current striking the rudder causes the ship to turn in the direction the rudder is put over. As the vessel gathers way, the effect of the screw current is lessened and the normal action of the rudder takes control. This is why a short application of full power ahead when the ship is stopped exerts the strongest turning effect without causing much advance. This is a most useful maneuver, but one which many shiphandlers are apparently hesitant to use. When the ship is proceeding normally and the rudder is suddenly put hard over, the stern will first move away from the direction of the turn. The ship then crabs off in the same direction as it slowly begins to turn. Due to momentum along the ship's original course, the ship will range ahead along an arc for a ship length or two before beginning to gain ground in the desired direction. The net distance traveled on the original course is called advance. The net distance traveled laterally before steadying on the new course is transfer.

   b. Ship and screw going astern. In this case the steering effect of the rudder is negligible until the ship gathers sufficient sternway. Meanwhile the screw current has started to swing the vessel's stern to port. However, if the screw is backed slowly, minimizing its thrust, full right rudder will take increasing effect and the stern will swing to starboard as sternway increases. If the rudder is put full left, the stern will swing rapidly to port. This tendency can be useful when turning in a short narrow space, provided the ship is turned to the right. By alternating full ahead on right rudder and full astern on left rudder, a ship may be turned quickly in a small area. The wind has a strong effect on vessels going astern. If there is much wind, the ship will back its stern up into it regardless of rudder or screw. Therefore, when turning in a narrow space with wind on one bow, make the turn away from the wind, backing the engine when the wind is well abaft the beam.

   c. Ship going ahead, screw going astern. It must not be assumed that the rudder will still affect the ship's head while the ship has headway. As soon as the screw is reversed, new forces are brought into effect. If the rudder is left amidships, the ship's head will fall off to starboard. If the rudder is put full right at the instant the screw starts astern, the ship's head will swing to starboard at first. The bow may continue going to the right but usually will stop, then slowly swing to port, the stern swinging to starboard as the ship gathers sternway and minds its helm. If the rudder is put full left at the instant the screw starts astern, the bow will swing slightly to the left at first, but as speed decreases it will fall off to starboard, since all forces are acting together to swing the stern to port.

d. Ship going astern, screw going ahead. If the rudder is amidships, the sidewise pressure of the screw blades counterbalances the discharge current striking the rudder, and it is not possible to predict the direction in which the ship will swing. If the rudder is put full right, the stern will go rapidly to port; if put full left, the stern goes rapidly to starboard. However, if the ship is making considerable sternway and full power is not being used, the steering effect of the rudder may cause the ship to back to her rudder until the sternway has decreased, when the discharge current of the screw takes effect and causes the ship to react as described above.

e. Clarification. In the two cases described above, of a ship going ahead with screw backing and a ship going astern with screw going ahead, the predictions of the ship's action are predicated on the use of full power on the screw under average conditions. Should speed through the water be high and only half power used, some of the tendencies noted may be reversed.

f. A swinging ship carries considerable momentum and tends to swing in the direction in which it started. Therefore, if conditions permit, start the swing with the rudder before using the engine to change the direction of the ship's movement. In this manner, the swing can be started in the right direction and the rudder and engines used to best advantage to continue the swing. When maneuvering a single-screw ship, remember that the position of the rudder depends on what the propeller is doing rather than on the direction of the motion of the ship through the water.

g. Different conditions. Remember that differences in trim, wind, sea, current, suction of the bottom, size of rudder, and propeller all produce new forces, or modify existing forces. Vessels may at times act in a manner other than predicted.

E. Bow Thrusters.

1. General. The traditional principles of shiphandling apply directly to the control of the ship's stern and indirectly to the ship's bow. In essence, one moves the bow by controlling the movement of the stern. Bow thrusters introduce another dimension to shiphandling. They allow the shiphandler to control both stern *and* bow. This enables the ship to work in conditions, side currents, and winds, that made some work previously impossible...or at least unthinkable. Considering the extra capabilities the bow thruster provides, conning officers should take extra care not to place the ship in situations where loss of the bow thruster would leave the ship in a dangerous situation.

2. Operation. Operation of the conventional bow thruster is simple. The screw, situated in an athwartships tunnel, is turned in opposite directions to produce thrust to either side. The value to the conning officer is readily apparent. He/she can now wind the bow into a buoy or pier or away from it. In a loss of steering situation, the bow thruster may be used to maneuver the ship. When working a buoy or launching a small boat, the bow thruster can be used to maintain the ship's heading without

employing the screws and rudder or risking developing headway. When backing, the bowthruster can be employed like a rudder making it possible to back down more narrow channels. Note that the bow thruster has its greatest effect at slow speeds. As the speed of the ship is increased, the effect diminishes. At two-thirds speed, the bow thruster will have almost no effect.

3. Combinations. When used in combination with the maneuvers listed in 5-C and 5-D above, a multitude of maneuvers are possible.

F. Maneuvering With the Bow Thruster.

1. General. Bow thrusters improve the maneuverability of vessels. Their installation greatly reduces the wear and tear on main engines, extending their useful life.

2. Walking. The basic principle behind walking a ship sideways is to thrust in the direction you want to move and put the rudder in the opposite direction. Since the stern moves opposite the direction of the turn, a vessel walking to port is thrusting to port with right rudder. Another way to walk sideways, on a twin screw vessel, is to thrust in the direction you want to go and twist in the opposite.

3. As a Rudder. Bow thrusters can act as a rudder when a vessel is backing. A single screw vessel with rudder amidships can back in a straight line steering only with the bow thruster. The evolution is carried off at slow speed. In this instance the stern becomes the bow. To turn the new bow to starboard you thrust to port and vice versa. Twin screw vessels equipped with a bow thruster can oppose screws and use their thruster to spin them 360° in the ship's length. They also can make the vessel go sideways for a short distance.

4. Approaching a Buoy. When approaching a buoy close aboard, take care not to catch the buoy in the prop wash from the bow thruster, as this can cause the buoy to move rapidly away from the ship. If this happens, however, simply stop the bow thruster and wait for the buoy to swing back toward the ship. Do not apply the bow thruster in the opposite direction, hoping to bring the buoy alongside. The buoy, when swinging back towards its original position may move into the side of the ship or dive under the hull. Conning officers must learn in which area off the bow the buoy will be affected by the bow thruster wake and plan their actions accordingly. The prop wash can be used to the conning officer's advantage occasionally by providing a cushion between the ship's bow and a pier.

5. Fouling. As with all machinery, bow thrusters require special care to keep them operating properly. Care must be taken not to allow debris to be sucked into the propeller.

6. Noise. The bow thruster engine is quite noisy and makes deck communication difficult. Have prearranged signals worked out so communication between the bridge and safety observer is not interrupted. The use of portable radios, sound powered phones, or radio-headsets is encouraged.

7. Casualties. Operations and training without using the thruster is encouraged. This will assist in preparing conning officers to handle the vessel if the bow thruster fails.

G. Maneuvering Around Buoys.

1. General.

   a. Maneuvering a buoy tender into the exact spot where a buoy is to be moored is not an easy task except under the most favorable conditions of wind and current. However, with a thorough understanding of the principles of handling ships in general, a knowledge gained from experience concerning the peculiarities of the individual ship, and a pilot's knowledge of the local conditions, a tender conning officer may maneuver the ship to drop the buoy's mooring with accuracy.

   b. The following things should be considered by the conning officer before working a buoy.

      (1) Current will have considerably more effect on your ship than wind. When the current is more than one knot you can usually ignore the effect of wind.

      (2) Headway or sternway will allow easier maneuvering. Water across the rudder provides the turning force.

      (3) A single screw cutter tends to back to port; however, it will eventually back into a strong wind as the side forces of the screw lessen due to increasing sternway. This lessening allows the force of the wind, acting on the sail area of the bow, to take over and push the bow to port (for a wind from the starboard side) causing a swing to starboard. A twin screw vessel can be backed straight by judicious application of screw(s) and rudder(s) but it will also want to back into a strong wind.

      (4) With headway, a cutter's pivot point is usually somewhere just abaft amidships. Without headway, it tends to move forward, away from the applied forces of screw/rudder.

      (5) In making a slow approach to a buoy, it will seem that the ship will never reach the desired objective. There is a point where the object, which has been moving almost imperceptibly, suddenly picks up speed. Find this point for your own reaction time.

      (6) Cutter movement can be detected immediately by the use of natural ranges ashore.

      (7) Discover how to give your crew the steadiest deck condition for working under any wind and wave conditions.

      (8) Find out where your cutter's sail areas are for any wind conditions, and how wind will turn you or cause you to drift sideways. Certain rules of thumb will emerge for your particular ship. The wind has the same effect as current or a bow thruster but is acting on the portion of the vessel out of the water and not on the underwater hull.

      (9) Practice crabbing your vessel across a current before you reach the buoy. See how much it takes to cause your bow to fall off to either side, and

what combinations return you to a stemming position most effectively. Discover as many combinations of screw/rudder as you can to achieve and hold equilibrium in a current. Often a vessel can maintain station in a current by applying a few turns and steering a particular heading. However, the vessel's position must be constantly evaluated so momentum will not be built in any particular direction, or to adjust to a change in wind or current.

(10) Learn to make your ship respond by using the elements. Never think of fighting wind or current; rather think of how best to use vector forces to assist you in handling the ship. On vessels without a bow thruster the wind and current can be used very effectively to maneuver around a buoy or for mooring. Ice also can be used very effectively as a maneuvering tool.

(11) In approaching a tight situation, try to consider all escape routes open to you and what forces you would apply to get clear. DON'T EVER GO IN WITHOUT LOOKING OVER SEVERAL WAYS OUT!

2. Approaching the Buoy.

a. Before approaching a buoy, consider the wind, current, swells, location of foul ground, and channel traffic. Take a fix to insure your position and that of the buoy in relation to shoals, etc. Unless local conditions make it inadvisable, it has been found that a buoy is best approached with the ship heading into the wind, seas, or current. Base your approach on whichever is the controlling or strongest factor. This permits the vessel to approach slowly, be stopped and straightened out if necessary. When alongside the buoy, it allows a quick application of rudder and engine, to correct a cant of the bow to either side, or to prevent drifting astern. Control your vessel so no quick water (wash) rises near a buoy about to be picked up. Never hook into a buoy while the vessel is in motion.

b. When approaching a buoy the wind or current may be brought a little on the opposite side to insure that the ship will set alongside the buoy. Once the buoy is hooked on, the bow of the tender must be turned back into the wind or current to avoid placing unnecessary strain on the gear. Keeping an eye on the flags or anemometer, or mounting a pennant or windsock on the jack will make maneuvering much easier. Experience is most important in this respect. Keeping the buoy or chain close aboard so hooking in and hoisting will be safer and easier, yet not allowing the ship to set down on the buoy or mooring, is very important. At no time should the bow be permitted to swing away from the current or wind so that the ship is set away from the mooring. Should this happen, hold everything and stand well clear on deck until the ship can be brought back under control by judicious backing and filling. After gaining experience you should be able to predict the next move required to keep the chain up and down based only on the amount and direction the vessel is off the wind.

c. For large buoys with a heavy mooring, many tenders work with the wind a point or two on the opposite bow to insure that the chain will lay alongside. However, if a ship is permitted to be set down on a lighted buoy, it may be dragged, or keel hauled. This will result in damage to the buoy's lantern and superstructure.

d. If the buoy is located close to a shoal, rocks or other obstruction, do not assume that it is on station and proceed blindly. Take danger bearings, position angles, soundings and approach carefully in every case. Determine the position of the buoy and the shoal before starting your approach. Remember that you are being called upon to take your ship into situations the ordinary mariner would avoid. In working buoys located in shallow water the following points may be of assistance:

(1) Watch your bottom contours. Use the information provided by your fathometer, leadline or small boats in approaching an aid and determining its correct position.

(2) Use the small boats as much as possible to work aids in shallow waters. They should also be used to sound and mark the work area.

(3) It is often difficult to judge the speed of advance of the tender due to the presence of current. Watch natural ranges for an indication or carry some small pieces of driftwood to be dropped overboard to gauge movement or current.

(4) Identify a prominent object or natural range to steer on rather than give numerous rudder orders. Under certain conditions it may be better to give courses for the helm to steer.

(5) When entering a restricted area ensure that all charts are the largest scale available. All danger ranges and bearings should be on all charts in use.

(6) Personnel shall be assigned to monitor danger ranges and danger bearings. This person shall have no other duties assigned. Personnel assigned these tasks shall provide regular and timely updates to the conning officer and Commanding Officer. If the vessel is standing into danger the personnel assigned these duties shall immediately notify the conning officer and Commanding Officer and shall receive acknowledgment from them that they understand the situation.

3. <u>Dredging the Anchor to Work Buoys</u>. Buoys can be worked by dredging the anchor with the wind on the beam or stern in tight situations. The amount of anchor and chain needed varies with each situation and some trial and error is necessary to get the right scope. A good starting point is one and a half times the water's depth. The only hard and fast rule is that the anchor should never be across the bow but should tend from the side on which it is dropped.

4. <u>Approaching the Buoy Down Wind Or With Following Current</u>.

a. Occasionally local conditions require that a buoy be approached down wind or with a following current. In this case remember to approach the buoy with less headway as the ship is moving faster over the ground. In working offshore, in a moderate swell, the greatest stability of a vessel is usually obtained by holding the stern to the sea. The buoys may then be prepared with the least difficulty and danger.

b. The cutter may be positioned to permit it to proceed on the desired heading while the buoy is being prepared. This will place the vessel in the correct position when the buoy is readied for letting go.

c. When working with the wind astern with a single screw ship, take care not to get the wind too far on either quarter. Be especially aware of keeping the wind off starboard quarter, when working alongside a hazard with an onshore wind. Should the wind get too far around on the quarter, when the ship is backed to clear the buoy it may not have space to back into the wind. The result is ending up broadside on the hazard due to the setting action of the wind. The installation of bow thrusters on some tenders has eased this maneuver for those tenders.

d. As stated above, some ships lay more quietly stern to the sea. Buoys, unapproachable in rough weather in normal fashion (i.e., ship heading into the wind and seas), may be worked with the sea astern.

e. Working aids stern to the wind or sea requires excellent shiphandling skills and use of good judgment. If reasonably possible, breaking off to return another day when conditions improve is not the sign of a poor seaman, but a prudent one.

5. Approaching a Marker Buoy. COMDTINST M16500.1 (series), Aids to Navigation Manual - Positioning, deals comprehensively with the various methods of locating the position of a buoy. Assuming that the exact station of the buoy has been located and marked with a small marker buoy, the problem remains to bring the ship to that spot so the buoy sinker may be dropped exactly on station. Care must be taken in approaching the small marker buoy. The slightest setting down of the ship on the marker will drag it off position. Remember, a marker is only a reference point, once a ship has touched a marker buoy, do not trust its position further; take new angles or position and verify. If a ship approaches a marker buoy with too much headway and has to back down furiously to prevent overreaching, the wash propwash from the bow thruster may shift the marker out of position. In fast current areas, marker buoys are often ineffective. The sinker size required to keep the marker stationary quickly becomes too large to deploy from the focsle. In fast current the use of a range, if available, is preferred.

6. Handling A Tender Alongside Buoy.

a. A competent shiphandler should be able to work buoys on either side of the tender; working port side to with a single screw provides the best advantage. This enables the conning officer to throw the bow away from the buoy when backing.

b. It is wise to keep the buoy forward of the vessel's pivot point, particularly for single screw ships. Most good shiphandlers have a rule that a buoy should never be allowed to get past the pilothouse. In this manner, the shiphandler can always move the bow quickly toward or away from the buoy. With the buoy abaft the pivot point, appreciable time is consumed before the ship will move in the desired direction. In handling buoys alongside as well as in approaching them, keep wind and current in mind constantly.

c. While approaching, the stronger of the wind or current (if opposed) is determined, and the vessel stemmed in that direction. However, eddies near the buoy can change conditions observed a few yards away. Sometimes a heading which is a compromise between the two forces will serve best to keep the ship steady alongside the buoy. In this case, a natural range off the beam and off the bow simplifies station keeping.

d. The importance of not permitting the weight of the ship to bear heavily against or away from the mooring cannot be emphasized enough. This problem plagues the shiphandler not only in approaching and initially hooking in, but remains as long as the vessel has the buoy alongside. Even when a buoy has been hoisted and griped down, the conning officer must remain alert and be ready to maneuver to maintain chain position.

e. Without natural ranges to assist, you must rely upon "moving chain reports" for station keeping. If you cannot see the chain, then you must rely on the chain caller and you must be attentive to the chain reports.

f. Take care not to build up way on the vessel while maneuvering to hold the ship alongside the buoy. Counteracting ship motion may require vigorous corrective action. This can easily evolve into a vicious cycle with disastrous results.

7. <u>Working in a Narrow Channel</u>. If the wind is on one side of the channel and the cutter is to relieve a series of buoys, relieve the buoys on the windward side first. If the wind has not changed when it comes time to work the leeward buoys, use an anchor to help keep the tender off the bank or shoal. If the channel is wide enough to permit the tender to work across the channel, work the buoys stern to the wind. If it is necessary for a tender to go up a narrow channel to relieve buoys and there is insufficient room to turn around, go up with the flood tide, drop an anchor to swing on, and work the buoys on the way out, stemming the current. If more favorable conditions are predicted, prudence dictates that you wait.

8. <u>In Shallow Waters</u>.

a. It is generally best to bring a tender into an area of shallow or uncertain depths during high tide. While this may be necessary on some occasions, for example when turning room only exists at high tide, there are times when it is not the best course of action. For example, it may be easier to detect hazards, and thus to avoid them, at low water. Also, should a vessel ground at low water, its chances of refloating during the subsequent flood would be far greater than if it were to ground at high, or even half, tide.

b. When working buoys where there is insufficient water to float the ship at low tide, it is best to work the buoys on a rising tide. This will help to avoid being caught and laying aground over a full tide interval. Certain types of hull forms may safely rest aground without capsizing. The ship should rise on the following tide if maintained absolutely watertight, and if there is not excessive mud suction.

c. Working buoys with the anchor at short stay is not recommended on rocky bottom or when working near a dangerous rock in tidal waters. It may snag and delay the prompt departure of the vessel long enough for damage to be sustained.

9. Miscellaneous Suggestions.

a. It is easier to add headway (momentum) than to take it off when working in tight quarters.

b. Remember to work with the elements rather than forcing the ship against them.

c. When working in swells with contrary wind or current, stem the swells, if possible, to minimize rolling.

d. Single screw tenders prefer to work buoys from the port side. This is because of the tendency of the bow to swing clear of the buoy as the ship is backing away.

e. When working buoys in shoal areas, take advantage of any stage of the tide or current that will tend to keep you off the shoal. Similarly take advantage of wind conditions.

f. Bear in mind that it is possible to set a buoy under sea and weather conditions that would make it dangerous to pick up a buoy.

g. If a choice must be made between maintaining the proper attitude of the vessel or staying on the buoy's charted position, seek safe water. The ship can always be maneuvered back to AP after the buoy deck has been secured and the buoy made ready to let go.

h. After the cutter is made fast to the buoy, find reference points on shore to detect any dragging. Once a ship fetches up on the mooring and does not drag, it is good practice to allow the ship to lay to the mooring and not work the engines unless necessary.

i. When backing away from a buoy, take care that the cage of a lighted buoy does not foul the anchor. Also, ensure that boats are not rigged out on the same side that buoys are being worked.

j. When setting a buoy, it is a good practice to have the wind or current a bit on the working side as the buoy goes overboard. This will facilitate backing clear, with the wind or current helping to set the ship off of the buoy.

k. When working in close quarters, it may become necessary to back the ship away from the danger before getting the mooring aboard. A cutting torch should always be immediately available on deck when working buoys, and more than one crew member should be trained in its use.

l. When a vessel equipped with a mechanical chain stopper is in a tight place, the chain may be quickly secured in the stopper and the vessel backed away to safety dragging the mooring along. However, in any case of dragging a mooring, unshackle the buoy and secure the chain with a pelican hook if time and conditions permit, as an added precaution.

m. The conning officer generally starts to maneuver the bow of the ship away from the buoy (so as not to damage the lantern) just after it is set. At the same time, the crew is clearing the hoisting tackle from the bale on the buoy. This maneuver should not be premature or too drastic until it is sure that the hoisting tackle is completely unhooked and clear of the buoy.

n. As the ship swings away from a buoy do not attempt to clear the buoy by putting the engines ahead without insuring that your stern and screw(s) will not foul the mooring chain. Never put your screw(s) near a buoy's mooring chain.

o. When working in open waters, head the ship on a course to minimize rolling when buoys are being hoisted or moved. In rough weather await a quiet interval when the ship is fairly steady before making any hazardous lift. Also remember that lifting a load off the deck has an adverse effect on the ship's stability, usually causing an increase in the roll period. (See Chapter 7)

p. Should a buoy start to swing wildly, a quick buoy deck supervisor will touch it to the deck just enough to steady it, taking care not to give it enough slack to become unhooked. A couple of blocks or wedges can be thrown under the buoy. The preferred practice is to use steadying crossdeck lines of ample size and never give the buoy a chance to move uncontrolled. Should a buoy break loose and take charge, it is possible to lower the boom right down on top of it and wedge it over against the bulwarks or up against another buoy until it can be secured. This may be a little hard on the gear but it is nothing compared to what the buoy could do if permitted to take charge.

q. On sideloading buoy tenders, there is danger in permitting the ship to move ahead too far with a buoy over the side and suspended from the boom. If the boom happens to be topped high and the buoy starts moving aft alongside the ship, the boom may jackknife back over the bridge, resulting in extensive damage and possible injury. The use of a preventer (the whip leading to the opposite deck & forward), may prevent this condition.

r. Twin screw tenders are noted for their different handling characteristics. Some can be easily turned in their own lengths, others need plenty of headway or sternway, even in little wind. Nearly all twin screw tenders require way through the water before being able to turn in high winds.

s. There is never a time when working an aid takes precedence over your ship and the people aboard it. The decision to work a buoy is always the commanding officer's, but even after starting it may be necessary to break off work and secure until another opportunity presents itself. Our aids are highly reliable and long lived. Servicing operations are planned to occur before visiting the aid becomes imperative; therefore, commanding officers have latitude in backing off and returning at another date.

t. When departing an area where a buoy has been removed for the season, proceed in a direction, including turns, away from the shallows. Never turn toward the shoal. Keep constant fixes, never rely on old information; you may have been set by the elements back toward the shoal. If you are in doubt, stop the vessel and determine where you are. If you need assistance to control the situation, get help.

H. Towing.

Aids to navigation tenders are occasionally called upon to tow other vessels. General facts about towing are given in *Knight's* and other standard texts on seamanship. Some vessels, especially those that push a barge, are not the best platform available for towing. The 65' and 75' WLRs and WLICs, should be used to tow only as a last resort and should never attempt to tow unless mated to their barges. All buoytenders shall ensure that their towing kits are complete and ready for use at all times.

I. Small Boat Handling.

1. General.

    a. An important phase of aids to navigation work involves the servicing of unattended shore aids. Frequently helicopters can be used for these servicing jobs. However, when other means are not available, the tenders' small boats must be employed. This requires competency in handling small boats and making landings on exposed coasts. Officers and crew who are experienced small boat crewmembers are essential for aids to navigation work.

    b. It must not be assumed that one who is an otherwise competent seaman has the necessary knowledge and experience to make small boat landings under dangerous conditions. This is an art in itself, requiring special knowledge and skill only acquired by practical experience. When undertaken by the inexperienced, the danger involved is very great.

    c. The handling of a small boat follows the principles of handling a single screw ship as described in previous sections, with due allowance being made for the difference in size.

    d. An excellent reference for small boat operations is COMDTINST M16114.5 (series), Boat Crew Seamanship Manual. Although written primarily for MLB and UTB boat crews, its sections on Marlinspike Seamanship, Safety Equipment, and Boathandling apply to all small boat crewmembers.

2. Lowering the Boat.

    a. A variety of davit types exist, including the articulating single point davits used to lower the RHIB on the WLB, and the hydraulic davits on the SLEP WLBs. The procedure below applies to MSBs, MCBs and any other boat lowered using crescent davits. The safety rules and procedures apply to all types of davits with the main differences being in number of hoist connections and weight distribution. On single point davits it is advisable to embark and disembark only the coxswain if the boat is not waterborne to prevent accidents during lowering and hoisting of the boat.

        (1) The boat is designated by the commanding officer through the officer of the deck. The crew don the appropriate survival gear, as dictated by the weather, take their positions, and clear away the gripes.

        (2) Frapping lines are used to keep the boat from swinging. Frapping lines are

passed around the falls and kept taut by men on deck. Most ships have a traveling lizard around the falls to which the frapping line is secured.

(3) Steadying lines should be secured in the boat. Many ships use only the frapping lines and sea painter. A sternfast line, if used, should be led well aft. Never place hands on the gunwale of a boat being lowered or hoisted or laying alongside another craft or solid object.

(4) Members of the boat crew stand by the falls and sea painter. When all is in order, deck supervisor commands "lower away together," or, if the boat is on the cargo boom or articulated davit and in chocks, "hoist away" and "swing out and lower away."

(5) Strain is taken on the frapping lines to steady the boat. Any slack in the sea painter and sternfast is taken in on deck. The sea painter is secured by a fid in the boat. A crew member stands by to clear the sea painter by pulling the fid when ordered by the coxswain.

(6) Crewmembers must tend the falls to keep them clear and to keep the blocks from striking members of the boat crew after the falls are let go. The boat must be lowered smartly, especially in rough weather. The falls must be lowered together, with the stern leading slightly.

(7) While being lowered, boat crewmembers shall hold firmly to the monkey lines. During lowering the monkey lines are laid over the side of the boat next to the ship. This keeps them from becoming tangled in the boat. The boat is not lowered entirely into the water until the deck supervisor determines that sea conditions are favorable and gives the order, "up behind." The persons, or in some cases person, tending the falls throw off the turns or otherwise allow the falls to pay out freely. The stern is kept lower than the bow during lowering to prevent the boat from digging into the seas and filling with water.

(8) As soon as the boat is waterborne, the coxswain commands "unhook aft" then "unhook forward." The after fall is always let go first unless the ship has sternway. Secure fore and aft falls via frapping lines immediately after unhooking. Expert boat handling is demanded. Sternfast and steadying lines are cast off and the coxswain gives the stern a sheer-in with rudder to get the bow out. The strain on the sea painter sheers the boat away from the ship's side.

(9) When clear of the side, the coxswain commands, "cast off the sea painter." When the boat is clear, the crew on deck should rapidly haul the sea painter aboard to prevent its being fouled in the boat's propeller.

3. <u>Hoisting a Boat</u>.

a. The same principles of good seamanship followed in lowering a boat are applied when hoisting it aboard ship. The most important task of coxswain and crew is to keep their craft away from the ship's side to prevent damage. The boat should never have to wait for preparations on deck. Boat falls should be overhauled, led along the deck, and well manned or taken around the drum of the winch.

b. When all is ready on deck and a lee has been made, the boat comes alongside and the sea painter is passed. The ship must have some way on, and once the sea painter is passed and secured the boat lays back and tows on it.

c. By proper use of the rudder, the coxswain can now hold the boat at the desired position off the ship's side. By moving the rudder, the sheer-in of the stern may be lessened and the boat brought in slowly to the ship. If the boat should lurch toward the ship, the danger of crashing against the side may be offset quickly by increasing the sheer-in of the stern and sheer-out of the bow, with rudder. The strain on the sea painter will then pull the boat clear. Do not make the sheer-off so radical that the sea painter must be cast off to avoid swamping.

d. When the boat sheers in under the davits, the falls, and steadying lines are passed. A line should be led from the stern of the boat to a point well aft on the ship to prevent the boat from lurching forward when it leaves the water. This sternfast is essential if the ship is pitching.

e. Crewmembers tending the falls while hooking on should hold them upright by the handles on each side of the block until a strain is taken and the boat hoisted clear of the water. Thus the block will not snap and whip about as the boat rises and falls in the seas.

f. If at the davits, when all is ready on deck and in the boat, hook forward, then aft, and hoist away. The boat should be hoisted quickly and steadily. Boat fenders should again be used to keep the boat from being damaged against the side of the ship.

4. Running a Line.

a. There are numerous occasions when a boat crew may be called upon to run a ship's line to a buoy, another vessel, or dock. When so ordered, the crew will coil most of the line in the stern sheets, and leave enough in the bow to make fast when the landing is reached. Be sure to have enough line to reach, and have plenty of good seizing stuff (small line used for binding) for securing. Have a hatchet or knife handy for cutting. If moving with the tide, take less line than you would otherwise. If against the tide, it is better to take all the line in the boat, pull up, make fast, and then bring the end back to the ship.

b. When required to layout a long heavy line in a strong current it may be necessary to have two boats. One to run away with the end, the other to under run the line at intervals floating it and pulling upstream with the bight. This lessens the line's resistance to the current.

c. When necessary to tow a heavy length of line, do not make it fast to the stern of the boat. Take a turn around the cleats forward so the stern may be free to pivot. This may prevent the boat from being set constantly to leeward in heavy seas with no means of bringing the boat's head up to the seas or wind. Be careful to keep the line out of the propeller. Always have a knife or hatchet handy in the boat.

5. Running Before a Sea. One of the more risky situations arises when a power boat is running before a sea. When the hull is lifted by the stern, there is danger that steerageway and power may be lost. This may occur when the screw and rudder are clear of the water. The boat may then swing around broadside to the seas and capsize. Coxswains must call upon all their skills and expertise in the use of the rudder to keep the stern to the heavy seas. It is helpful to reduce speed, and to allow large swells to roll by.

6. Running into a Sea. Running into a sea is less hazardous, but not without peril in bad weather. Reduced speed will lessen the strain on boat engine and hull. To this end, the throttle should be adjusted so the bow will rise with oncoming waves rather than drive into them. Taking seas on one bow is sound seamanship. Avoid the trough except in an emergency. When moving broadside to the waves, swing the boat momentarily to take larger wave crests on the weather bow, then return to course when conditions permit.

7. Boat Handling in Rough Water.

   a. The forces exerted by waves and breakers are tremendous and must be understood and respected. A poorly or improperly handled boat is almost sure to be swamped, broached, or pitchpoled.

   b. Swamping results from seas breaking into the boat or from permitting a breaker to strike the boat on the bow or quarter and slew the boat around until the seas are on the beam.

   c. Pitchpoling results from permitting the boat to ride on the shoreward or front side of the sea. The stern is elevated and the bow depressed into the slower water at the base of the breaker. As the resistance on the bow increases, the stern is raised higher and higher until the boat is toppled over, end for end and bottom up.

   d. Adequate speed to overcome the force of breakers must be used when heading into them. Use only speed necessary to keep the boat under control and prevent being carried back by the surf. Too much speed will have a tendency to drive the boat into the oncoming sea or cause the bow to fall too heavily after topping a sea and will place unnecessary strain on the boat.

   e. If at all possible, handle the boat so the heavier breaking seas are avoided. If this is not possible, maneuver the boat to meet the breakers squarely so their force will be equally distributed on each bow.

   f. In running with a surf, maneuver the boat so the seas will break ahead. Adjust speed to permit the breakers to pass the boat. Do not try to ride the surf. Trim the boat by the stern and keep the stern in such a position that overtaking breakers will meet the stern squarely with equal force on both sides.

8. Landing Through a Surf.

   a. Rubber boats are especially helpful in landing in surf, with the usual procedure being to ride in on the back of a wave. The following points are suggested as possible methods for reducing the difficulties of a surf landing. Since surf conditions are dependent on such variables as tide and wind, the prudent boat handler will wait for particularly vicious surf to die down before attempting an otherwise hazardous landing.

b. When approaching the outer line of breakers, bear in mind that the height of the sea viewed from offshore is deceptive. The seas will appear much smaller and less dangerous from seaward than they actually are. Watch the succession of seas and begin the run for the beach during a comparatively mild interval. When the run is started, use enough speed to keep the boat under control. Be prepared to check the way of the boat to permit overtaking seas time to pass.

c. Landing may also be accomplished by using a surfline anchor. Drop an anchor from the stern of the boat just outside the breakers; keep a strain on the line and pay out the anchor line as the boat moves through the surf. The surge of the sea usually will carry the boat toward the beach as quickly as desired. If not, headway can be increased by use of the engine.

d. The offshore end of the surfline can also be made fast to another small boat instead of to an anchor. The other boat may be anchored but usually it is kept underway when there is a strong current parallel to the shore so the line can be paid out in directions that will permit the boat to pass through the breakers end-on to the sea. The line should be cut instantly if the boat will not pass through the surf end-on.

e. In addition to employing a surf line (with anchor or small boat) attached to the offshore end of the line from the boat, an additional hauling line can be attached from the inshore end of the boat to the beach. Depending on surf conditions, and with competent assistance on the beach, the boat is simply hauled back and forth through the surf. This method is especially desirable when several trips must be made.

f. As soon as the boat lands on the beach, the crew should leap out and pull the boat up well out of the way of the seas.

g. At some locations, because of the changeable nature of the surf, it may not be possible to retrieve personnel. Therefore, some planning should be put into exposure and survival equipment when operating in remote areas.

9. Simple Landings.

a. When surf is not a major problem and a simple landing with a larger motor launch is to be made, and where the current or wind may turn the boat broadside to the beach, anchored surf lines may be effectively used.

b. As the boat heads in toward the beach, an anchor is dropped from the quarter, well outside the rough water. The boat under power then quarters off toward the opposite side and another anchor is let go from the opposite quarter. Preferably this is done to windward, in such a position as to give the largest possible span.

The boat is then headed for the beach, veering the surf lines as necessary. The bow is driven into the sand on the beach.

c. The boat is then held bow on to the beach, with the nose in the sand, the surf lines tending at an angle from each quarter and resisting the tendency of the boat to twist up broadside to the beach. Should the boat get broadside, it might sustain injury to the propeller or rudder and getting clear of the beach would be difficult.

d. With the boat held bow-on to the beach with surf line, getting clear involves nothing more than heaving on the surf lines and backing the engine. The surf lines may be used to overcome any tendency of the boat to back into the wind or sea or to back to port. As in all cases where lines are over the side, care must be taken that the lines do not foul the propeller.

e. In any case where a powerboat is landed on a sandy beach remember that the sand kicked up by the turbulence of the propeller stream or surf may enter the cooling system and possibly put the engine out of commission.

10. Summary.

a. Important rules to follow with small boat landings under difficult conditions are:

(1) Use only experienced personnel.

(2) Conditions never appear as dangerous from seaward as they really are.

(3) Keep the boat under control.

(4) The outermost series of breakers is usually the heaviest.

(5) In a strange locality, lie-to outside the breakers to study the particular conditions before attempting a landing.

(6) The primary danger, when running before a sea, is that of broaching.

(7) A number of heavy swells are often followed by a short and comparatively mild interval.

(8) Launching a boat through breakers is a more difficult and exhausting operation, though not a more dangerous one, than making a landing under similar conditions.

(9) An entirely different technique is required on a steep, rocky shore than is required on a gently sloping sand beach.

(10) On a rocky shore, the locality selected for landing should be free from nearby breakers. Small areas partially enclosed and subject to violent surge (to-and-from movements) of the sea should be avoided. The best landing place is one having a fairly steep face, where rocks are not covered and uncovered by the swell; ideally, the location should offer an adequate foothold. The swell here has less tendency to break or may not break at all.

CHAPTER 6: ICE OPERATIONS

A. General.

1. References. There are several standard texts on icebreaking that provide guidance and should be reviewed prior to working in ice. *Polar Operations Manual* (USN) is devoted entirely to ice operations. *Knight's Modern Seamanship* and *Naval Shiphandling* both devote chapters to the subject. American Practical Navigator (Bowditch, Vol. I) is anther good source. These texts deal mostly with polar operations and buoy tenders rarely work in polar regions. The differences between polar and domestic ice breaking are substantial and tenders will find themselves working in ice of various types and thicknesses. A large portion of the assistance provided occurs in wind-driven ice, restricted river channels, or refrozen brash. The vessels will also be relieving buoys in ice and performing ice-related flood relief. A good source of information on domestic icebreaking is *A Handbook of Ice Operations for the U.S. Coast Guard's WTGB Class Cutter*, by CDR Lawson Brigham. His research paper is a compilation of information about WTGB methods and contains some valuable analysis on several ice-related accidents involving Coast Guard cutters. CDR Brigham's *USCG 43 Meter Icebreaker Operational Performance and Techniques on the Great Lakes* is another possible reference.

2. Planning and Importance. Icebreaking and its associated activities **are not** "seat of the pants" operations. Any evolution in ice should be approached only after careful analysis of the prevailing weather, sea room, and ice conditions. Whenever possible, use the elements and sea conditions to assist with ice operations.

3. Overview. The methods suggested in this chapter are techniques that have been employed successfully by others. Tenders without experience may find that these methods will help them to operate safely until some experience is gained. However, not every situation can be covered in this text and thoughtful innovation is encouraged.

B. Domestic Ice Breaking Definitions.

1. Definitions. The following definitions are associated with ice in the Great Lakes and coastal waters.

AGE - The length of time since ice formed.

ANCHOR ICE - Ice attached to the bottom.

BALL ICE - Formed when small ice chunks of any type are trapped in extremely turbulent water which is at the freezing point throughout its depth. The particles grow by coalescence or accretion to form soft, spongy spheres up to three feet in diameter.

BARE ICE - Ice without snow cover.

BRASH - Conglomerations of small ice cakes and chunks which have been broken off from other ice formations. These conglomerations coalesce and refreeze into irregularly shaped masses, one to six feet in diameter, usually with sharp projections. Brash ice can extend all the way to the bottom of an ice-congested waterway.

CAKES - Detached segments of ice sheets. The following shows the recognized categories of Cakes/Floe measurement:

Cake - Less than 20 meters (22 yds) across

Small Floe - 20 - 100 meters (22 - 109 yds) across

Medium Floe - 100 - 500 meters (109 - 545 yds) across

Big Floe - 500 - 2000 meters (545 yds - 1.1 NM) across

Vast Floe - 2 - 10 Kilometers (1.1 - 5.5 NM) across

Giant Floe - More than 10 Kilometers (5.5 NM) across

COVERAGE - The ratio of water surface covered by ice to the total surface area at a specific location or over a defined area. Ice coverage is always reported in tenths.

CRACK - An opening in the ice sheet or floe that is not navigable by a ship. (A good rule of thumb is: If you can jump across it, it's a crack. If you can't, it's a small lead.) See LEADS.

DRIFT ICE - Any unattached ice formation. Any area of ice other than fast ice.

FAST ICE - Immobilized ice formations. Ice so firmly frozen into place (along the shore or held by islands) that winds and water currents cannot dislodge the formation.

FAST SHEET ICE - An ice field.

FLOES - Detached segments of floating ice sheets. See CAKES.

FRAZIL - Fine spicules or ice crystals that float freely and individually in the water.

GREASE ICE - Where the water surface is completely covered by frazil but the crystals have not yet begun to freeze together. The surface has a greasy, matte appearance and may look like an oil slick.

ICE EDGE - The boundary, at any given time, between the open sea or lake and ice of any kind, whether drifting or fast.

ICE JAM - Formed when drifting masses of floes and cakes are forced into convergent motion by the configuration of shorelines and/or fast ice formations.

LAKE ICE - Ice formed on a lake, regardless of observed location. Nearly all ice on lakes can be classified as either "blue" or "white." Blue ice consists of closely packed water crystals with relatively few impurities. White ice incorporates large quantities of air.

LEAD - Any opening or passageway through sea ice that is navigable by a ship. Different variations:

Blind Lead - A lead blocked at one end (dead end).

Shore Lead - A lead between the pack ice and the shore.

Flaw Lead - A lead between pack ice and fast ice.

PLATE ICE - Flat ice with approximately uniform thickness and without ridges/windrows.

PANCAKE ICE - Predominantly circular pieces of ice. Pieces are one to eight feet across with raised rims resulting from the pieces striking against one another.

POLYNYA (Pronounced "Pul en ya") - A water area enclosed in ice, usually fast or any non-linear opening in the ice cover. This water area remains constant in size and usually has an oblong shape. Some of these are recurring, due to the natural upwelling of warmer water currents.

POOL - A small body of water (usually fresh melt water) in a depression or hollow in ice. Also known as a MELT POND.

PRESSURE RIDGE - A line or wall of broken ice forced upward and downward by pressure. This is usually formed when two floes collide with each other.

RAFTED ICE - A type of ice formed by one floe overriding another. Some parts of the overlap will trap water which may freeze and cement the two floes together. Other parts will trap air and take on the characteristic white appearance.

RIND ICE - A brittle, shiny crust of ice usually less than three inches thick. It is formed on a quiet surface by direct freezing or from grease ice. Ice rind is easily broken by wind or swell and usually breaks into rectangular pieces.

RIVER ICE - Ice formed in or carried by a river, regardless of observed location.

ROTTEN ICE - Ice that has become honeycombed because of melting and is in an advanced state of disintegration. Rotten ice may appear transparent (dark) when saturated with water.

SEA ICE - Any form of ice found at sea which has originated from the freezing of sea water.

SEA SMOKE - Fog formed when water vapor is added to air which is much colder than the vapor's source. This most commonly occurs when very cold air drifts across relatively warm water.

SHORE ICE - A basic form of fast ice that is attached to the shore or grounded in shallow water.

SKIM ICE - Where frazil crystals have frozen together, but do not yet exhibit tensile strength. Ripples may move through skim ice.

SLUSH - Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

WHITEOUT - An atmospheric optical phenomenon in which the observer appears to be engulfed in a uniformly white glow. Shadows, horizon, and clouds are not discernible; sense of depth and orientation is lost. Only very dark, nearby objects can be seen. On the Great Lakes a uniformly overcast sky, blowing snow and an unbroken ice cover can contribute to a whiteout.

WINDROW - Rows of ice piles formed by drifting masses of floes and cakes being pushed against the shore or against fast ice by the wind. Windrows continue to grow as long as the wind persists.

C. Open Water Transits.

1. General. There are several situations faced by an unescorted vessel in severe winter conditions that can place the vessel and crew in great danger. These include being beset in the ice (and possibly having the vessel pinched out of the ice) and ice accretion (icing of the superstructure and decks). Icing, which poses the worst threat, occurs only in open water areas. A vessel caught in heavy seas can actually find relief from icing and the rough seas by entering an ice field.

2. Icing. Icing can occur very rapidly and can significantly reduce the vessel's stability (by raising the vessel's center of gravity). Because icing normally occurs when the wind and seas are running, this loss of stability can result in broken masts, booms, davits, and lost boats. Extreme icing in heavy seas can cause capsizing and loss of the vessel. Use your vessel stability program to compute your maximum icing capability when icing occurs.

3. Fresh vs. Salt Water. Vessels operating in fresh water are more prone to icing than those in salt water. This is because fresh water freezes at a higher temperature than salt water. The Great Lakes pose particular problems because of the shorter wave period vessels encounter there. Severe icing can occur in relatively small seas as the bow breaks each succeeding wave and throws spray into the cold air.

4. Tactics. Because of the speed with which icing can imperil a vessel, the Commanding Officer should always consider alternatives when conditions are favorable for icing. Consider a sheltered route, if available, and slower transit speed to lessen the amount of spray sent up by the bow. Tack off the wind and seas. If the ship is not responding to an emergency, it may be prudent to seek shelter in a safe harbor, and delay sailing until conditions improve.

5. Dealing with Topside Icing. If icing is encountered and a safe refuge is not available, it may be necessary for the vessel to come about periodically and run with the seas so ice can be removed by the crew. A transit under these conditions is very tiring for the crew, and should be avoided. Ice should be removed with wooden baseball bats or ax handles. Metal malls and hammers should never be used because they may damage the deck or superstructure.

D. Transiting in Ice.

1. General. The best advice for a vessel transiting an area covered by ice is to go around if possible. If you can't go around, look for the easiest route to transit.

2. Night Transits. Transits of ice fields at night are not recommended. The ability to judge ice thickness and to distinguish pressure ridges at night is greatly reduced. At night, vessels have entered into heavy ice and become beset. Others have tried to force a route, spending hours backing and ramming with little headway, only to find a very easy transit in the morning because they were able to avoid the windrows and

pressure ridges in the daylight. Most vessels that routinely operate in ice have ice lights (mounted on the bow). They use these in combination with their searchlights when they must transit ice at night. Even with this artificial lighting it is still very difficult to avoid all of the obstacles in an ice field.

3. Ice Damage. Ice is capable of causing serious damage to propellers, rudders, and hull plating. Vessels should always place the rudder amidships before backing down in ice. This prevents ice from becoming jammed between the propeller and rudder and to keep from bending the rudder stock. Bow thrusters should not be used in ice. Thrusters are useless in ice and may be damaged by ice ingested into the tunnel.

4. Ice Dangers and Responses. The greatest danger in transiting an ice field is loss of propulsion or maneuverability. This can result in a vessel becoming trapped, especially in a moving ice field, and either driven aground or forced out of the ice and stranded. If the vessel is forced out of the water there is very little chance to maintain any equipment unless it has keel coolers. In several vessel classes, ice has a tendency to clog sea strainers and block cooling water to the main engines, ship service generators and main motors. This problem occurs most frequently in brash ice. Even if a beset vessel is not pinched out of the ice, there are other potential dangers. If a vessel is caught beam to a moving ice field, ice may start to drive up and over the deck, forcing the vessel to heel over be or pushed under the ice. Keeping the doors in the buoy ports when transiting ice fields is recommended. The doors will help keep ice off the buoy deck should the vessel be disabled. If it becomes necessary to secure propulsion in moving ice, maneuver the bow into the oncoming ice first. This will allow more time for repairs before the ice forces the situation.

5. Obstacles. In domestic icebreaking, it is usually not necessary to follow leads in ice (because of the reduced thickness compared to arctic ice). The greatest obstacles are windrows and pressure ridges. Skirting these, and transiting through unbroken plate will allow for the safe passage of most large tenders. If a vessel must back and ram to force a passage, great care must be taken to keep the vessel from being driven into several succeeding windrows whose separation is less than twice the length of the vessel. The tremendous pressure ice exerts is readily apparent when a vessel cannot maneuver because of a windrow at the bow and stern or even worse at the bow and amidships. It is best to chip away at windrows until the opening in the windrow is large enough to allow the vessel's passage.

6. Backing and Ramming. When backing and ramming, the vessel need not back more than two ship lengths from the ice edge. Backing further will result in too much momentum. The vessel may be carried so far up on the ice that it cannot back off. Remember the bow shape allows the vessel to ride up the ice and it is the weight of the vessel that breaks the ice, not the bow as bludgeon or speed. Breaking ice often requires a great deal of patience to accomplish an evolution safely. Cycle the rudder prior to starting a back and ram evolution to wash away ice from the stern. Ensure the rudder is amidships while backing.

7. Method. A ship breaks fast ice by riding up on the ice and breaking it as the weight becomes greater than the ice can support. This effect is assisted by the buoyancy of

the stern of the vessel. The bow rides up on the ice, and consequently the stern is driven down into the water. However, because the water pressure is greater than that exerted by the stern, the stern will be forced up again exerting downward force on the bow. This additional force gives the bow added breaking action. Vessels moving well in ice will demonstrate this "hinge" characteristic.

8. Utilizing Sinkers. Vessels making unescorted transits are recommended to carry a sinker large enough to roll the vessel from side to side when moved from port to starboard; a sort of "heeling system." This will assist the vessel in extracting itself should it become beset.

9. Sallying. "Sallying the Rudder" has long been recognized as an effective method for forcing a passage through ice. This is a procedure in which the helmsman shifts the rudder from left to right in nearly equal increments of ten or more degrees while maintaining a general heading. The rudder is shifted by the feel of the vessel. As the vessel starts to answer the rudder in one direction the helmsman then shifts the rudder, so the effect of the constantly shifting rudder imparts a roll to the ship. This technique will often prevent the vessel from becoming beset once it starts to slow, but is of limited use if the vessel has already come to a stop. Additionally, the screw turning and moving the rudder prevents ice damage. Use extreme caution when sallying the rudder near shoals, in restricted waterways, or near other vessels.

10. Fixing Position. Since a vessel transiting an ice field cannot always follow a set course it is critical that the position of the vessel be fixed accurately and often to prevent a mishap.

E. Escorting and Assisting Vessels Beset in Ice.

1. General. Buoy tenders often assist other vessels through ice. Some of the same shiphandling rules that apply for working buoys apply when assisting beset vessels. However, as with most rules there are exceptions and times to depart from them, use common sense.

    a. One primary rule for any operation in ice is to always use the ice and wind conditions to your advantage.

    b. A long held rule for icebreaking with single screw ships is, whenever possible, to make a starboard side approach to the vessel being assisted. This is to prevent the escort from backing into the beset vessel should her progress be stopped. However, some forces that apply to single screw vessels in open water, like backing to port, do not necessarily apply when operating in ice. For example, any ship operating in ice will tend to follow the path of least resistance. This means a single screw vessel may back straight out the same track it made instead of backing to port.

    c. The general rule is that the assisting vessel should never break ice on the leeward side of a vessel. This is to keep the assisting vessel from becoming beset, and having the assisted vessel blow down on the assisting vessel. However, if there is a heavy wind the beset vessel will have ice piling up on the windward side. It will also have ice packed against the leeward side as the wind pushes the vessel onto the ice. If ample sea room exists to break the restricting plate on the leeward side, your efforts may be better rewarded there. The beset vessel may be set into the open tracks on the leeward side faster than the moving ice can fill them in, allowing it to fall in behind the escort. Efforts on the windward side may only break free more ice to pile against the vessel as the wind pushes the plate into the track behind you.

d. While these maneuvers work well in plate, where ample sea room exists, they are not recommended in narrow brash-filled channels because vessels operating in brash ice react more closely to their open water handling characteristics.

2. Expanding Margin of Safety. Never restrict yourself to a close maneuver if ample sea room exists to give you a safer margin for error. As explained above, you can sometimes deviate from the accepted approach by taking advantage of the elements and your maneuvering area without placing your vessel at risk. There are times when working very close to a vessel in restricted waters dictates that you follow procedural theory. When sea room exists, however, utilize it to provide a greater margin of safety while completing the vessel extraction. While ample power must be applied to break an ice jam, be aware when working in close quarters, that your vessel heading may fall off into the assisted vessel. Also be aware that your wake is effective in breaking ice when adequate speed is possible. Use extreme caution using high speed near other vessels.

3. Primary Tasks. Your main task when assisting a beset vessel is relieving pressure, reducing friction and providing a less restricted path for the vessel. You want to complete this as efficiently and safely as possible, with safety being the paramount concern. In ice, a vessel will always seek the path of least resistance. This law of physics should be exploited to the maximum extent possible. This same law is the quickest way for a vessel to get in trouble when working close to another vessel in ice.

4. First Passes. The first passes down the side of a beset vessel should be made at a distance equal to the length of the assisting vessel, if possible. This is often sufficient to relieve the pressure around the beset vessel. It also will allow you to judge the thickness of the ice and identify any weak areas along the vessel if closer passes are needed. The reason such a distance from the beset vessel is recommended is to allow sufficient room to swing the stern should a low pressure area draw the assisting vessel toward the beset vessel. Most collisions that occur are the result of the stern striking the beset vessel as the assisting vessel attempts to maneuver out of a sheer.

5. Areas for Concern. The areas around the bow and stern of the beset vessel are where low pressure areas are most likely to occur. This is a result of the prop wash and backing of the beset vessel weakening the ice as it attempts to free itself (See **Figure 6-1**.) As the assisting vessel approaches either end of the beset vessel it should begin to open the distance between the vessels and be prepared to maneuver to avoid a collision.

F. Vessel Types.

1. General. Each of the many varied types of vessels you may have to assist has its own personality. Each has its own unique combination of hull form, horsepower, and handling characteristics.

2. Wood or Fiberglass. Exercise care when maneuvering in the vicinity of wood or fiberglass vessels, as excessive ice movement could damage their hulls.

3. Large Vessels. Large vessels and tugs pushing a tow will require assistance at turns. Obviously, the vessel's stern swings in the opposite from which direction the vessel is turning. To facilitate this motion, you will have to break ice ahead of the vessel in the direction of the turn and aft of the pivot point on the opposite side.

4. Ice Dumping. These vessels will also require places to dump ice from the bow at periodic intervals, especially in refrozen brash, or several parallel tracks so ice displaced by the vessel's passage has somewhere to go (See **Figure 6-2**.)

5. Vessels with Large Sail Area. When there are high winds, light tows and bulk carriers have difficulty maneuvering in the ice because of their large sail area. Also their lack of ballast often results in the screw and rudder being partially out of the water, further reducing usable horsepower and limiting maneuverability. Vessels being assisted in the ice should be asked to ballast down to as near a normal trim as possible. This will increase their efficiency in the ice. The added ballast will also help them to transit short stretches of ice of varying thicknesses. When escorting a vessel through wind-driven ice you may have to make several parallel tracks leeward of the main ice sheet. The ice from the windward track, which should blow faster than the main ice sheet, has somewhere to go. This will relieve the pressure for the escorted vessel (See **Figure 6-3**.)

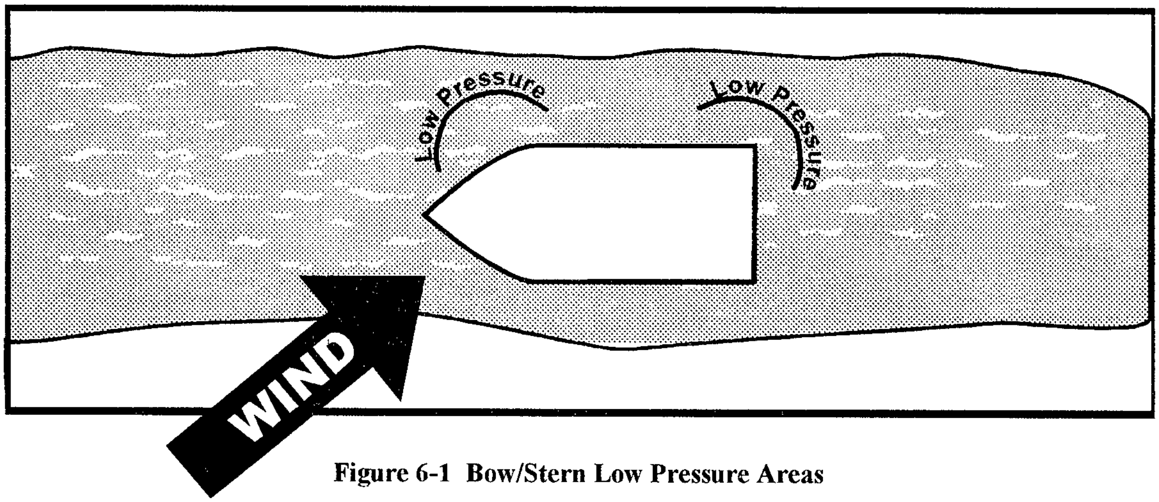


Figure 6-1 Bow/Stern Low Pressure Areas

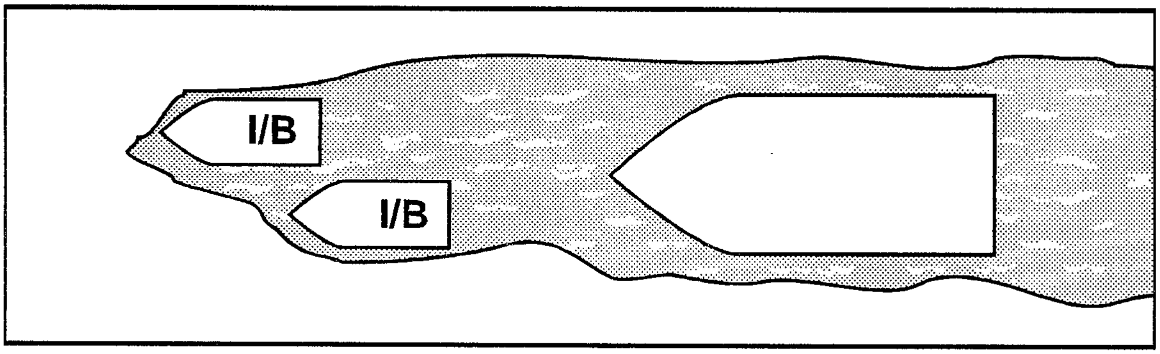


Figure 6-2 Parallel Tracks

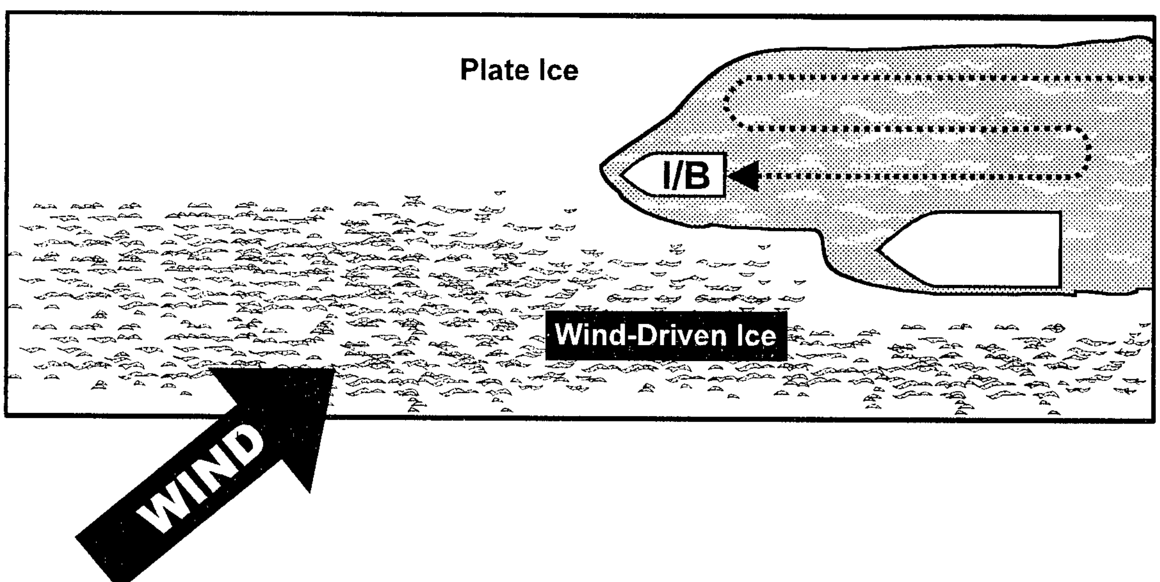


Figure 6-3 Escorting Vessels in Wind-Driven Ice

6. Getting a Light Vessel Started. To get an otherwise unimpeded light vessel started you may have to back down on the bow of the beset vessel and then come ahead with full power. This will push ice away from the bow and lubricate the beset vessel's hull with water. Light vessels, once started, can usually follow in a well prepared track. They just require a fairly clear stretch to build momentum.

7. Draft. When escorting a vessel through an ice field you must know their draft. You are assuming a degree of responsibility for the safety of the vessel you are escorting. You must maintain a constant plot so you do not inadvertently lead the vessel into waters you can safely navigate but which exceed the draft of the escorted vessel. Remember you are in charge of the operation.

G. Convoy Techniques.

1. General. Often the only efficient way move many vessels through wind driven ice or brash-filled rivers is in a convoy. However, the safe completion of a convoy requires a knowledge of the vessels involved. You need to know their horsepower, length, and draft. You also will have to come to an agreement among the vessels as to minimum following distance, general communications procedures and radio frequencies. You must keep in mind that your cutter is more powerful, for its size, and much more maneuverable than the vessels you are assisting. Therefore, you must make all turns and set safe following distances from the perspective of the vessels you are escorting.

2. Ability. The vessel with the highest horsepower to length ratio should be placed at the head of the convoy (measure of ice-breaking ability). Vessels with lesser ratios of horsepower to length should then be lined up in descending order. This will help to alleviate the problem of vessels with lesser ratio of horsepower to length becoming beset and halting the progress of the convoy.

3. Methods. There are several ways for the escorting vessel to handle a convoy. One way is to break track ahead of the lead vessel and allow the rest of the convoy to follow without further assistance (See **Figure 6-4**). Another way is for the escorting vessel to break track ahead of the convoy. Then break a parallel track back to the convoy. This works well if the escort can maintain a high enough speed to keep a track broken a safe distance ahead of the lead ship (See **Figure 6-5**.)

4. Drawbacks. The drawback to single ship operations is that the escort may have to fall back to assist a straggler and may not be able to keep the convoy moving with any regularity. In the past, cutters have left stragglers (in no danger) and assisted the bulk of the convoy, then returned to assist the straggler directly.

5. Multiple Escorts. Often several ships will be assigned the convoy escort task. This greatly simplifies the operation. One vessel can break track leaving the other vessel to break a parallel track or assist vessels in the convoy as necessary (See **Figure 6-6**).

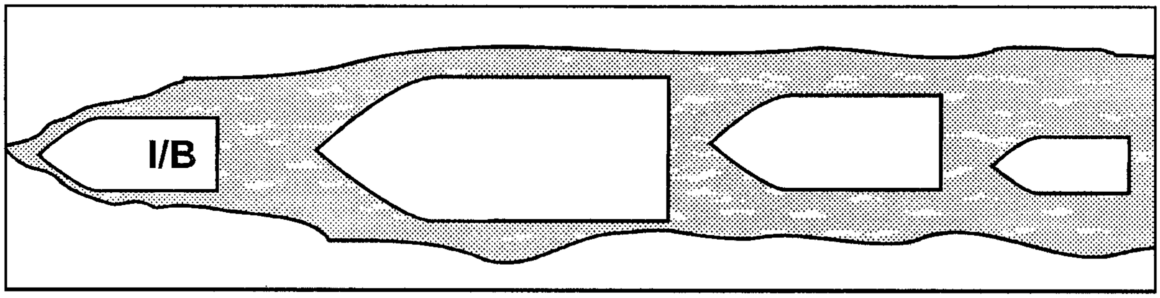


Figure 6-4 Breaking Track Ahead of Lead Vessel

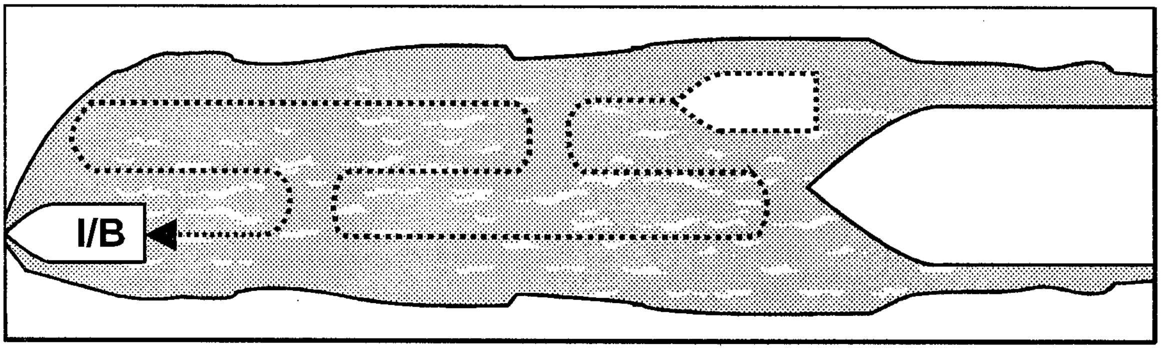


Figure 6-5 Breaking Track Ahead - Parallel Track Back

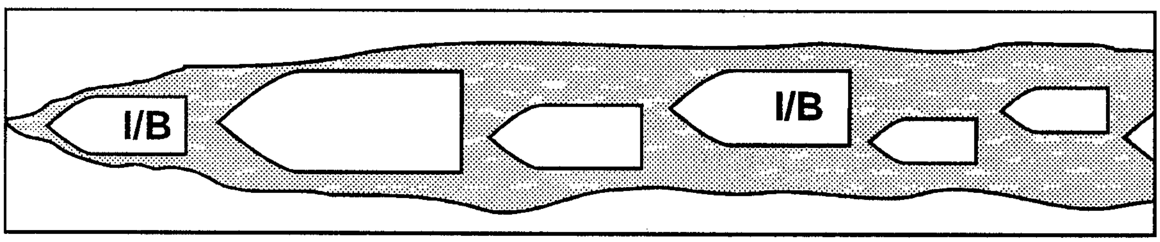


Figure 6-6 Several Ships Escorting Convoy

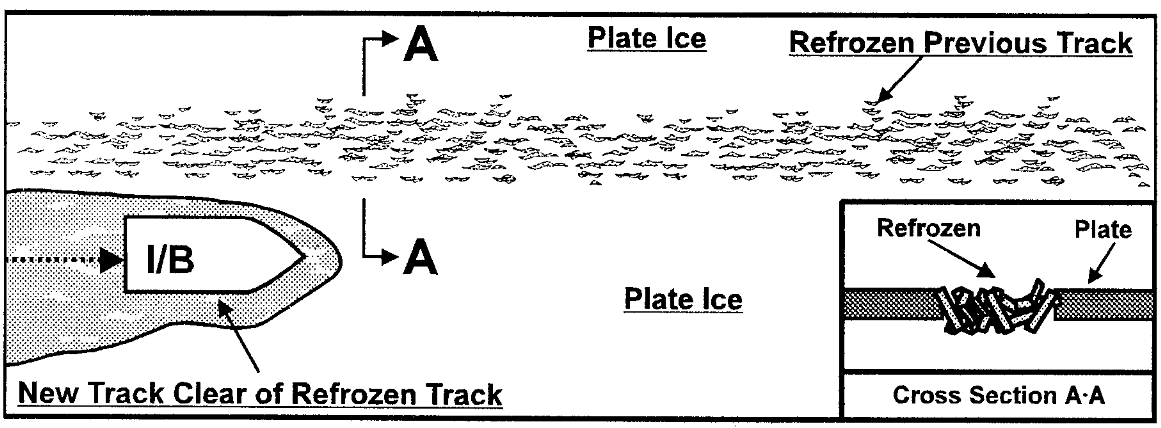


Figure 6-7 Old and New Tracks

H. Towing in Ice.

1. General. The hull form, horsepower and fiber towlines used by buoy tenders are not conducive to towing of vessels in ice. Therefore, buoy tenders should not tow in ice except as a last resort to prevent loss of life or property.

I. Communications Safety.

1. General. Communication between the vessel assisting and the vessel being assisted have to be established before any action is taken. This is the key to preventing collisions in the ice.

2. Inter-vessel Communication. Make sure the master of the vessel you are assisting understands exactly how you are going to approach, when to use and not use his engines, and what following distance to maintain. Immediately inform the escorted vessel of any ridge or condition that could slow your progress to prevent a collision.

3. Ensure Compliance. Never assume that the master of the vessel is going to do as you have requested. In the past, masters of vessels have put turns on, when for safety reasons, they have been asked to wait until the assisting vessel was clear. At other times they have run so close on the stern of the escort that collision could not be avoided when the escort became beset. It may take frequent reminders to the master to gain compliance with your wishes. Remember, you are in charge of the operation, but you may find yourself frustrated by a halfhearted effort on the part of the beset vessel to free itself.

4. Constant Contact is Essential. There should always be a visual or sound backup system used with the radio to communicate with the master of the vessel being assisted. This can be used to alert the master that he needs to act to avoid collision with the assisting vessel should it become beset or slowed. Some vessels have yellow or red warning lights aft. Others vessels have blue law-enforcement lights. These should be controlled from the bridge. If lights are not available, a system of whistle signals or signal flags can be used. It is important to use the signal each and every time there is a problem, even if the radio is working. This serves to familiarize the personnel on the assisted vessel with the signal system should the radio fail.

J. Flood Relief Operations.

1. General. Flood relief operations are common during the spring of the year. The Coast Guard assists in these operations when requested by the Army Corps of Engineers or local authorities.

2. Background. Flood relief operations are necessitated by ice jams forming in rivers, stopping or restricting the flow and causing the water to rise above flood stage.

3. Cause of Jams. Jams may be formed when plate ice at the mouth of a river prevents the flushing of broken ice from upstream. Jams can also be caused when the ice on a large body of water breaks up. Then if it is forced, by wind or current, into a constricted waterway, the ice moving under pressure will ground on islands, at bends in the waterway and on shoals. Ice can completely fill a channel from top to bottom, end to end, and render all but the most powerful vessels useless.

4. Debris. When a vessel is involved in flood relief, watch for debris (trees, buoys, refrigerators and even cars) floating on or just under the surface, to avoid damage to the propeller and rudder.

5. Method. Always attack an ice jam from downstream if possible. Ice in a river should be broken sufficiently to allow water pressure to move the ice out of the channel. Working from upstream only adds material to the jam. If a vessel must approach from upstream, the vessel can usually force a passage from upstream to the downstream side without causing a drastic deterioration of the situation. Then the vessel can attack the jam from downstream. Know where the current runs the strongest and concentrate in that area to leverage your efforts. In tidal areas, break on the ebb to increase your effectiveness.

6. Types. Some ice jams can be easily cleared by first breaking the restricting plate below the jam. Then attack the plug directly. Other ice jams are more extensive and will require a concerted effort and several days to remove, especially by tenders.

7. Utilizing Old Track. In some channels with a heavy current large pieces of plate ice can be piled up with the edges up on the downriver side (See **Figure 6-7**). Once a track has been broken it is advisable to make all subsequent transits upriver in a broken track and break new ice headed downstream. Using this method will significantly reduce the amount of backing and ramming required.

8. Procedure. When loosening ice, break from the river's edge to the center, since the outside edges have been grounded on the shoals. This pressure has to be released before the center ice will move. Once the ice starts moving it will be necessary to "groom" the ice edge so new growth does not occur. Without the grooming, ice will ground, starting from shore at each new constriction or bend and work toward the center of the channel, forming a new ice jam. It is best to attack the moving ice edge at a shallow angle from upstream. If not, the vessel may cause an ice stoppage as it turns by forcing the ice toward the edge of the channel.

9. Maneuvering. When an ice jam breaks it is sometimes impossible for a vessel to even maintain station against the mass of moving ice. The best advice is to maneuver the vessel with all power to the center of the channel, with the bow headed upstream. This will give the vessel the best chance to prevent damage until further maneuvers can be executed to extract the vessel from this precarious situation.

10. Transiting. When transiting restricted waterways try not to disturb fast ice, which could drift down current and cause an ice jam. Keep in mind that your wake may break fast ice.

K. AtoN Operations in Ice - General Safety Considerations.

1. General. Some buoy tenders will be required to service buoys in ice conditions.

2. Overview. The manner in which the buoy is worked will depend on variables such as type and thickness of the ice, nearness of shoal water, and speed and direction of ice movement.

3. Conditions. Always try to use ice and wind conditions to your advantage. Never

approach a buoy in ice without maintaining a good plot of the location of both the tender and the buoy. Reference points are often obscured or unreliable because of poor visibility. Distance and speed of advance are more difficult to determine in moving ice.

4. Patience. Never rush an evolution; there are too many accidents that can happen when people are working on a cold slippery buoy deck. If one plan isn't working, it is advisable to stop, allow the crew to warm up, and develop a new plan.

5. Precautions. Precautions should be taken to minimize danger to the crew. Ensure that personnel on deck are adequately clothed and equipped with safety glasses, hard hats, safety shoes and life vests. Sending a person out on the ice should be only a last resort. If you must send someone out, ensure that the person is wearing a survival suit or exposure coveralls, is attached to a life line and carrying a boat hook. The boat hook is used to probe the ice for weak spots, or is carried horizontally to break a fall should the person go through the ice.

6. Remove the Ice. When working a buoy with significant ice growth, always remove as much ice as possible from the buoy before bringing it on deck. Often a buoy in otherwise open water will have a collar of ice at the waterline. Removing this ice while the buoy is outboard of the buoy port allows you to maintain better control of the buoy. It also prevents damage to the main purchase from exceeding the weight limit and reduces the chance of a crewman being injured by falling ice or by slipping on deck.

7. Methods of Ice Removal. Several methods have been tried over the years to remove ice from buoys. Generally any method that causes the buoy hull to vibrate without damaging the buoy or endangering personnel will be effective. The vibration of the metal breaks the ice away from the buoy hull. Blacksmith hammers, sledge hammers, pry bars, and air hammers have all been used effectively. Shotguns with 00 buck shot work well for clearing lifting eyes.

8. Warning. Do not attempt to lift a buoy by the cage. Buoy cages were never designed for lifting a buoy. Keep in mind that there may be several tons of accumulated ice on the buoy. It is not unusual for ice-covered buoys to hang horizontal when lifted out of the water.

L. Working a Buoy in Fast Ice.

1. General. Buoy tending in pancake, skim, or fast ice, less than four inches thick, is the same as buoy tending in open water since buoys in ice of this type are usually visible.

2. Approaching a Buoy in Fast Ice. When working a buoy in fast ice, in excess of four inches, approach the buoy as close as possible. This will prevent ice from getting between the vessel and the buoy and forcing the buoy too far away to be hooked. This may mean setting almost a collision course for the buoy. Use only enough power to bring the buoy abeam the ship at the buoy port. This way you can use the ice to stop your forward movement and maintain station while working the buoy. The buoy may be on its side but still visible above the surface. If the buoy is heavily iced it may be necessary to clear the lifting eye with a shotgun.

3. Locating a Buoy Under the Ice. A buoy that has been forced under the ice can be located by relieving the pressure around the buoy, allowing the buoy to surface. In fast ice it may be necessary to determine what the wind direction was several days before. This will give you an indication of which direction the buoy and chain are led. This minimizes the chance of wrapping a buoy in the screw. Always keep the stern of the vessel well clear of the estimated watch circle. Buoys often leave a trail of broken ice as they force their way to the surface. This trail is very useful in finding buoys that have been dragged from AP. If unable to cut relief tracks due to shoaling, station a person on the forecastle with a marker. If the buoy is driven under during the approach, toss the marker over at the bow. This will give the conning officer an idea of his speed in relation to the ice and help prevent overriding the buoy. Once a buoy has been brought alongside, maneuver the vessel so moving ice is forced around the bow and just clears the buoy. Take care to not get canted so far that the ice sets the ship onto the buoy and mooring. The unequal pressures present in ice make it nearly impossible to keep station with anything other than the bow facing into a moving ice field. A pass by the buoy position may also crack the ice and allow the buoy to surface.

M. Working a Buoy in Moving Ice.

1. General. Because of the deceptive nature of a moving ice field it can present one of the most challenging buoy evolutions. The ice is usually of varying thicknesses and consistencies, which will introduce variable forces to your station keeping problem in the same manner as a gusting wind. The tender can actually be set away, onto, or worse, overshoot the approach on a buoy that has gone under the ice. Since the ice and the tender are constantly moving, if the buoy is forced under the ice it will be almost impossible to gauge the tender's movement or location in relation to the buoy. A natural range works well but may not be available. The best way to approach this situation is to determine the direction the flow is coming from. If there is sufficient sea room for maneuvering, break a track from the buoy into the flow. This way the buoy will surface in a broken track and will be visible during the approach. You will find it necessary to maintain turns in a moving ice field in the same manner as stemming a current. The critical part of the evolution is to lift the buoy hull clear of the ice before the unbroken ice field reaches the buoy. Depending on the ice field's speed of advance and the icing on the lifting eyes, this evolution may have to be repeated several times.

2. Clearing the Lifting Bail and Hoisting the Buoy. Sometimes a boat hook or shotgun with 00 buck will clear the lifting eye. It may even be necessary to swing a small sinker from the main to knock ice loose. In the worst cases it may be necessary to ram the buoy to clear enough ice so you can hook the buoy. This procedure is described in detail later. After the buoy is hooked get the chain into the stopper as fast as possible. Moving ice will break around the chain and you can effectively stem a flow while lifting the sinker. Again, you should always maintain a constant plot of your position in moving ice.

N. Clearing Ice from a Buoy by Ramming.

Heavy ice accumulation may force the tender to remove ice by ramming the buoy with the bow. During the execution of this evolution, use only enough speed to make contact with the buoy. At the time of impact the tender should be backing to prevent overriding or striking the buoy so hard as to cause damage to the cage. Under no circumstances should so much speed be used that the buoy advances past the buoy port. It will be necessary to place a person on the fo'c'sle to call distances and directions for the conning officer. Buoys have a tendency to "walk" away from the bow of a cutter, and course corrections may be necessary. Ramming should be used only to remove ice in excess of 24 inches, because of potential for serious damage to the buoy hull.

O. Towing Buoys in Ice.

It may be necessary to drag the buoy to safer water before attempting further retrieval efforts. Towing a buoy in ice is very dangerous and should be executed only after everyone involved understands the evolution. Towing a buoy away from a shoal because of prevailing ice movement may be necessary to prevent hazard to the vessel. Because of the dangerous nature of this evolution it should be considered only when faced with the possible loss of the buoy hull. It is much cheaper to replace a lost buoy than to replace hull plate.

1. Procedure. Buoys should be towed by a line attached through a lifting eye. The buoy should never be towed while hooked into the main purchase. Instead the line should be passed through the chock forward of the chain stop and attached to the cleat above it. Enough slack should be left in the towline so the buoy can slip into the track left by the vessel as it backs away from the shoal. There may be an initial hesitation if the sinker is well mudded in.

2. Safety. There is great potential for parting the towline on a stubborn mooring. All personnel must be kept well clear of the towline when towing a buoy in ice.

P. Mooring/Unmooring a Vessel in Ice.

1. General. Vessels operating in an ice environment will often have to moor or get away from a slip or dock that is clogged with ice.

2. Getting Underway. Even thin plate ice can prevent a vessel from springing. If so, use a large sinker suspended by the main over the side to break the ice. If there is sufficient room ahead or astern the vessel can be moved forward or aft in the slip so the sinker can be used to break ice the full length of the slip. This will improve the chances of the vessel getting away from the pier easily. In heavier ice moving a sinker from side to side can heel the ship, breaking the ice grip on the ship at the waterline. In a more restricted mooring, alternating turns ahead and astern while shifting the rudder may weaken the ice sufficiently to allow the vessel to get away from the slip. Vessels operating in ice should use the largest size mooring line that can be handled by the ship's personnel for lines 2 and 3.

3. Mooring. When mooring in ice keep in mind how you intend to depart and plan accordingly. You may want to leave a piece of fast ice between the ship and pier to assist you in getting away, or you may want to clear a slip of enough ice to allow you room to maneuver when you depart. Mooring a vessel to a solid pier clogged with ice

can be very frustrating if approached with insufficient speed and angle of approach.

a. One mooring technique in heavy ice is to leave an "ice fender" between the ship and the pier. To accomplish this, make a standard approach but aim the bow at the pier short of the stern's final position. When the vessel is close enough to the pier leave roughly three feet of ice between the vessel and the pier face. Maneuver the vessel parallel to the pier, maintaining the bow angled toward the pier. This can be accomplished with 5 - 10 degrees of rudder. If the bow is allowed to fall off, the size of the ice fender will increase and force the vessel away from the pier. Maintain speed or the ship's head will seek the low pressure area away from the pier allowing the "ice fender's" size to increase. However, there is the possibility of a low pressure area next to the pier that could veer the ship's head toward the pier. The conning officer has to keep this in mind so action can be taken to prevent damage to the vessel. Taking turns off will generally allow the ice to stop the vessel immediately. Since a vessel will always seek the path of least resistance in ice, a vessel getting underway, having approached in the above manner, can merely back out the same track it entered. The ice fender will prevent contact with the pier and the vessel can simply take in all lines and back with the rudder amidships.

b. When mooring in shifting ice, always moor with the bow upstream and canted toward the pier. This will prevent ice from getting between the pier and the vessel.

CHAPTER 7: CARGO HANDLING AND STABILITY

A. General.

1. Type of Gear Transported. Buoy tenders are frequently required to carry cargo that may be difficult to stow and secure. While cargo handling has evolved from large loads designated for supporting LORAN Stations, light stations or other outlying units, to more localized operations such as own-ship provisioning, cargo handling principles remain the same. Cargo handling not only involves moving provisions and equipment between the ship and pier, but also between the ship and small boats and within the ship. Moving provisions and equipment or machinery between spaces and up or down ladders requires the same approach as when moving externally. The use of bulkhead or overhead mounted padeyes with chain falls or come-alongs replaces the boom as the handling gear. But the rigging practices are the same. Cargo handling procedures are as critical today as ever. We do not approach it as a major evolution, though, except when loading buoy equipment. As a result we overlook basic techniques. As each buoy trip presents a new stowage problem for handling and securing, so does every provisioning evolution.

2. Planning and Distribution of Cargo. The most important phase of cargo handling is planning for the proper loading and distribution of cargo. You should note that the practical side of loading a vessel does not always conform to the theoretical. It is possible, with experience, to make segregations of the various types of cargo suitable for hold or on-deck stowage. Trim and stability are crucial factors to consider when planning stowage and will be further elaborated upon in Section D. Care must be exercised in the distribution of weight fore and aft and athwartships to maintain the vessel's proper trim.

3. Special Cargo Requirements. Before handling or stowing any cargo you should ensure that any special requirements are met. Any material requiring a Material Safety Data Sheet (MSDS) should be cleared through your Hazardous Material Coordinator and/or Engineer Officer before being brought on board.

B. Cargo Handling.

1. General. Cargo handling and stowage require many skills and different items of equipment. This section will cover the basic techniques of cargo handling including commonly used equipment and safety precautions.

2. General Equipment.

   a. Pallets are small platforms on which cargo is placed where both platform and cargo may be moved as a unit. Cargo is stacked on pallets in uniform loads. Items placed on a pallet for loading should be secured to the pallets before moving. If the item is to remain on the pallet for transport and stowage on board, it should be secured with metal banding. If it is just for handling and will be moved about the ship, then only a temporary lashing is necessary. Depending on the size of the material on the pallet, spreader bars should be used to prevent damage to either the cargo or slings. The box pallet has sides, as its name indicates. It is employed for small items or cargo that maybe damaged by crushing. This allows handling items without the need to secure them to a pallet (See **Figure 7-1a**.)

b. Cargo nets are used to advantage when handling non-uniform packages. The nets may be made of manila, wire rope, or more commonly, of nylon webbing. Depending on the size of the load, cargo net beckets maybe attached directly to the hoisting hook. They may also be used with a four-legged (or ganged) bridle (See **Figure 7-1b**.)

c. A save-all is a device used to prevent the loss of cargo overboard. The most common type of save-all is the cargo net. However, wood platforms, wire rope nets, or tarpaulins may also be used. There should be a save-all rigged wherever light cargo handling is taking place between the ship and pier (See **Figure 7-1c**.)

d. Slings are widely used in the moving and hoisting of heavy loads. Fiber and synthetic line slings offer the advantage of flexibility and protection of finished material. Note that these slings are not as strong as wire rope or chain slings. Furthermore, fiber or synthetic line are more likely to be damaged by sharp edges on the material being hoisted. Wire rope slings offer the advantages of both strength and flexibility. Three commonly used types of slings are: endless, single leg (or strap), and bridle (ganged) slings.

NOTE: Sling angle is extremely important for the safety of the lift by maintaining the safe working limit of the sling. It also prevents damage to the load (See Figure 7-1d.)

e. Chain hoists provide a convenient means for hoisting heavy objects. The slow lifting travel of the chain hoist is advantageous for permitting small movements, accurate adjustments and cautious handling of loads. Chain hoists differ widely in their mechanical advantage, depending upon their rated capacity. The load capacity of a chain hoist usually is stamped on the shell of the upper block. The lower hook is the weakest part of the assembly. This is intended as a safety measure so the hook will spread before the rig is overloaded (See **Figure 7-1e**.)

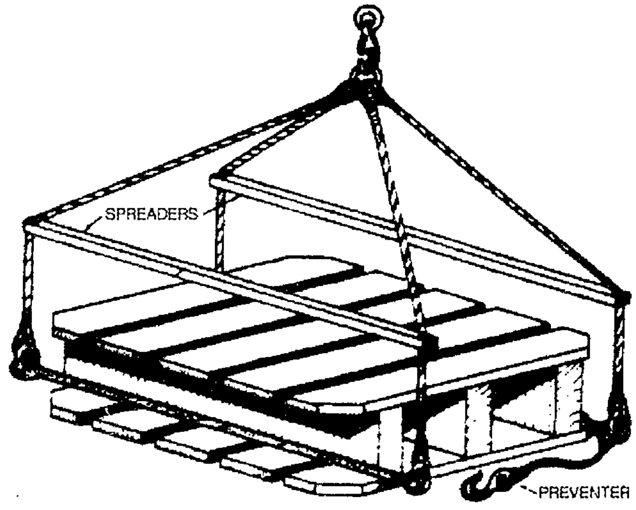


Fig. 7-1a Pallet

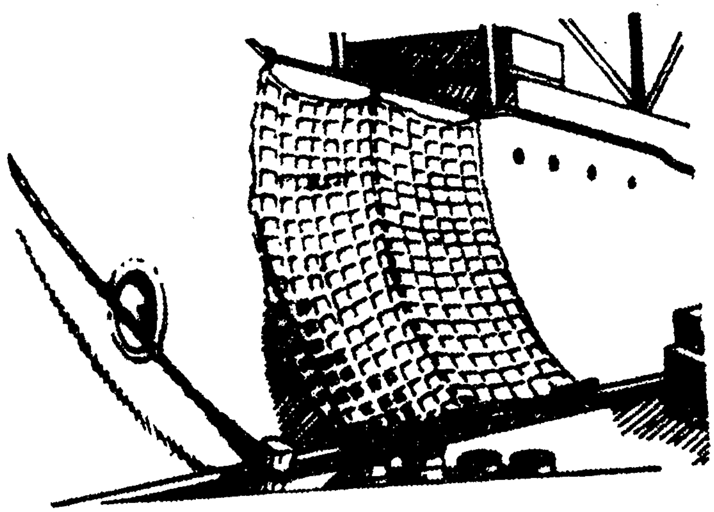


Fig. 7-1b Save-all

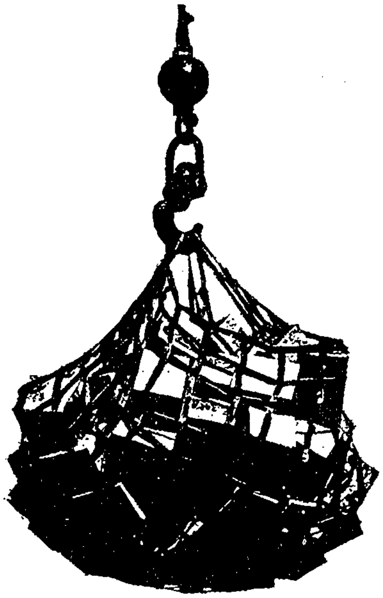


Fig. 7-1c Cargo net

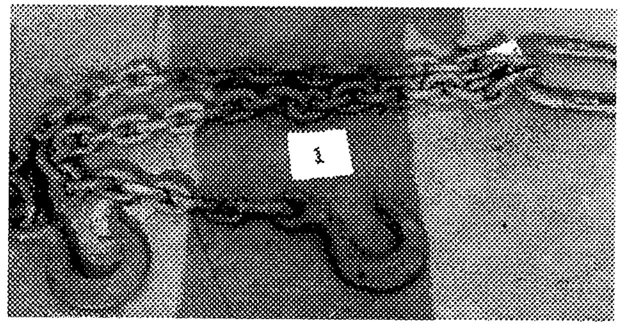


Fig. 7-1d Chain sling

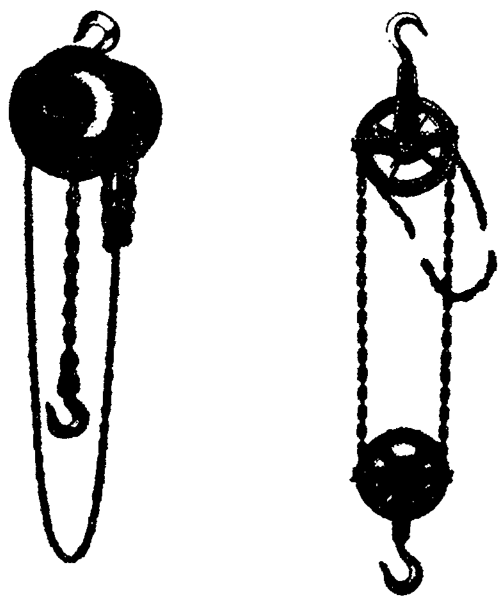


Fig. 7-1e Chain hoist

f. Come-alongs are designed with either chain or wire rope. They are normally light in weight and come in a variety of sizes. Come-alongs are reversible so the load may be raised or lowered (See **Figure 7-1f**.)

g. Barrel slings are designed specifically for handling barrels similar to oil barrels. This style of drum has a chime and chime hoops that are designed to withstand the force applied during hoisting. If the condition of the barrel is in doubt use of a choker sling or rigging a barrel hitch is recommended instead of the barrel sling (See **Figure 7-1g**.)

h. Beam clamps facilitate securing snatch blocks, block and tackles, etc., in places where it is not possible to rig a strap, or where padeyes do not exist, either on the overhead or on bulkheads. Different styles of beam clamps are available to meet the different types of beams that may be encountered (See **Figure 7-1h**.)

i. Dunnage is any material utilized to protect the ship and the cargo. Wood is the most common type of dunnage, but materials such as cardboard, heavy paper, burlap, etc., can serve a similar function. Use dunnage to:

(1) Prevent movement and chafing, by blocking off and securing containers. Also, it fills space that cannot be filled with cargo.

(2) Separate cargo.

(3) Allow for drainage and ventilation. Laying dunnage athwartships or fore and aft permits air to circulate. This prevents the accumulation of moisture by allowing it to flow into the drainage system.

(4) Increases friction between deck and cargo to prevent shifting of loads.

(5) Distributes load. Any deformation of a steel deck results in point loading when inflexible loads are placed on the deck.

j. Chocks.

(1) Similar to dunnage.

(2) Distributes the load.

3. Cargo handling.

a. Before beginning any handling evolution, determine the weight of the cargo. Appearance can be deceiving. Whether dealing with small boxes or large objects, you need to determine their weight in order to decide whether you can safely manhandle them or whether you should use weight-handling gear. The *Rigging Manual* and *Handbook for Riggers* provide methods for determining weight.

b. When cargo is being hoisted or lowered, avoid letting it swing, as much as possible. Usually, swinging can be prevented in the hold, on deck or on the dock by dragging or touching the load until it is spotted under the boom. Once it is in the air, maintain control of the load by the use of one or more steadying line(s). When handling any type of cargo that will be suspended in air, it is mandatory to attach tag lines to the load. One or more tag lines, as needed, will provide control

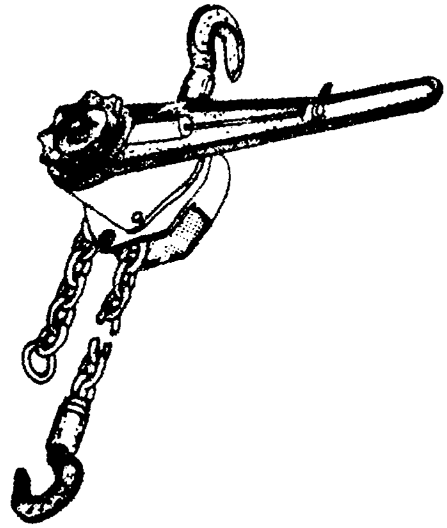


Fig. 7-1f Come-along

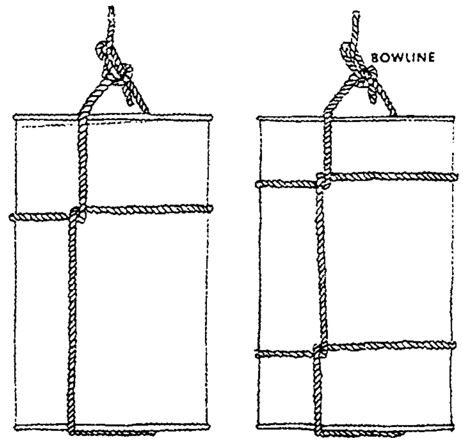


Fig. 7-1g Barrel sling

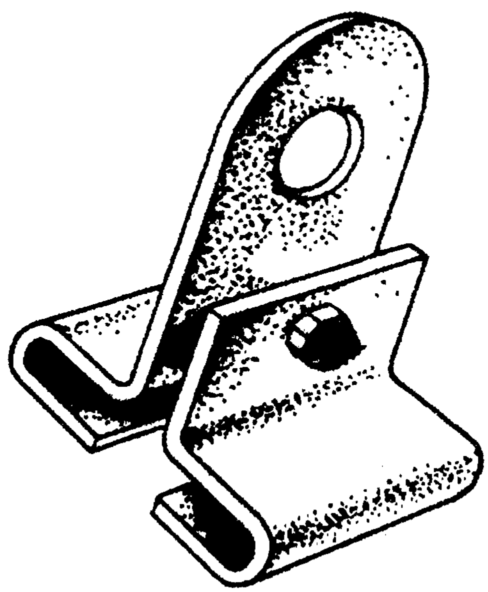


Fig. 7-1h Beam clamps

c. of the load and prevent rotation or unnecessary swinging. They will also assist controlling the landing of the cargo on deck. It is important that the tag lines be attached to the load and not to the hook. Once the hook has been disconnected from the load, a tending line is then shifted to the hook for control while it is being moved (See **Figure 7-2**.)

d. When moving machinery, equipment or other objects around the ship, using established methods not only makes the evolution safer, but also easier. It often seems easier to manhandle something up or down a ladder. The result is that someone ends up standing under the load, or is injured while attempting to out-muscle whatever is being moved. By using a tag line and either a block and tackle or a come-along, you can yard the object up or down the ladder without anyone being endangered. Furthermore, the object is better protected with the positive control being used. Beam clamps of appropriate size can be used to rig where overhead padeyes are not installed (or where safe working limits/test data are unknown) (See **Figure 7-3**.)

4. <u>Stowage of Heavy Cargo</u>.

a. Heavy cargo should not be stowed in the ends of a ship. A vessel so loaded will steer badly or will ship excessive water over the bow. In addition to the usual precautions taken to safely lift and stow heavy cargo, take care to spread out the bearing surface. Stout timbers laid fore and aft, which are long enough to distribute the weight evenly over all exposed frames, should be prepared to take the bearing points of the weight. As a rule, stowing heavy cargo amidships and in the wings will result in a more comfortable ship in a seaway. Since the raising and lowering of weights in a ship's hold has a direct effect on the vessel's stability, the distribution of cargo should be consistent with the vessel's stability and load diagrams.

b. Some tenders may transport vehicles. Vehicles require the use of wire slings with spreaders sufficiently long to keep the wires and/or vehicles from being damaged by compression during lifting. Dunnage must be placed on deck under the wheels; then the wheels are chocked securely and the chocks braced. Two lashings are required on the front, and two on the rear, of such vehicles as trucks and construction equipment. These lashings may be either crossed or led outboard from the vehicle. The chassis should be blocked up to take the weight off the body, and compression applied by lashing off the springs. Lashings may be made fast to front and rear axles instead of chassis lashing. In this case, it is not necessary to block under the springs.

c. Use of Manpower.

(1) After landing, you can move stores into place, either by hand or by use of ship's power. Crew members can push or bar cases into position. Crowbars are used by placing the pointed end of the bar under the end of the case, then lifting upward and forward.

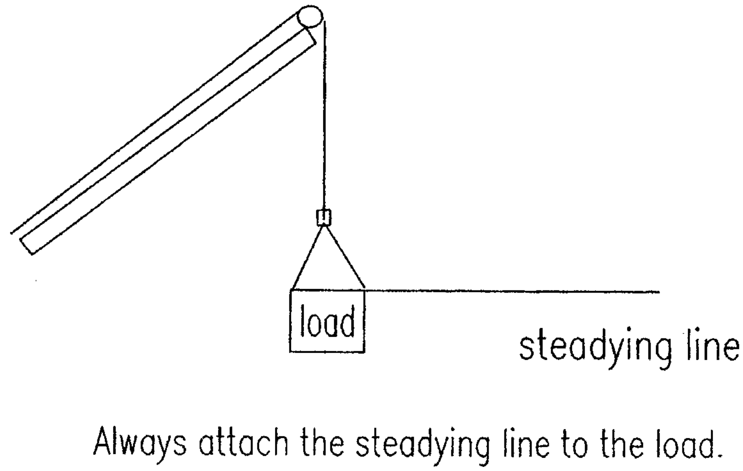


Fig. 7-2 Steady line

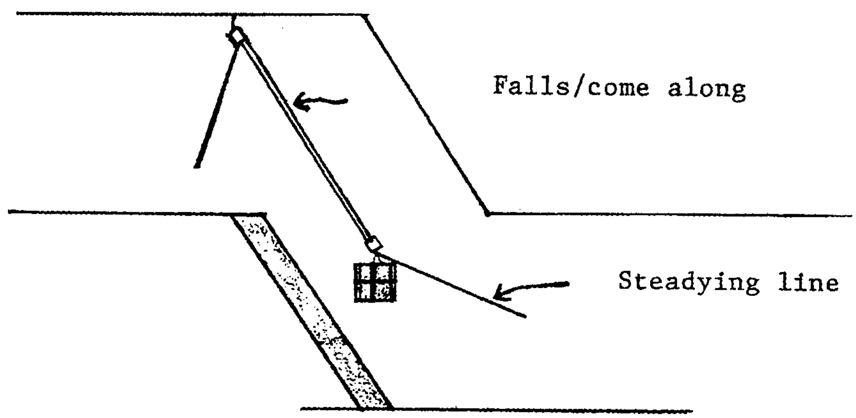


Fig. 7-3 Moving draft up/down ladder

(2) Heavy cases should not be landed flat on the deck. Rather, they should be set up on blocks or dunnage to facilitate discharge and prevent damage.

d. To accomplish final shifting of a few inches for precise stowage, crowbars again may be used. One or more bars are placed with the toe of the bar under the case, lifting it sufficiently to allow a good bite for the pointed ends of other bars used as explained above.

e. Final Stowage.

(1) When it is not possible to stow an item against other heavy cases, it must be securely braced and chocked to prevent any movement. Every consideration should be given to making the job as easy as is practical.

(2) A load can be moved a short distance into a wing, forward, or aft, of the square of the hatch, by removing the sling from the end of the case toward direction of storage. The load is then picked up with the remaining sling until the case is at an angle of about 30° with the deck.

(3) Place a roller under the end of the case resting on the dunnage. The case will move on the roller in the desired direction as the falls are rapidly slacked off.

(4) Heavy cargo may also be moved by the use of a dragline or hookline. When using a dragline in the holds, take care that there will be no danger to crew members stowing these items. Lead the dragline to the windlass to avoid having to use the ship's boom, except when light loads are being hoisted on the whip.

(5) The dragline should be clear and should not rub or chafe on any part of the ship's structure. A fair-lead can be obtained by using snatch blocks. The dragline may be made of wire rope instead of nylon or manila. The leads on which the snatch blocks are hung should be of chain or wire rope. Use dunnage liberally where the leads are made fast, to prevent damage to the deck.

(6) Keep crewmembers clear of all lines. If possible, use rollers under cases to reduce strain on the dragline. If the case is too heavy, you may rig a tackle. If necessary, improvise a tackle by using additional snatch blocks. When overhead clearance is sufficient, you can use beam clamps to hang a snatch block. This permits the case to be lifted into place under the wings, or fore or aft of the square of the hatch.

(7) To save time and work, place heavy cargo, cases, or vehicles headed in the direction in which they will be rolled or dragged when they are landed.

(8) To remove, by ship's power, wire rope slings from closely packed cases, unhook opposite ends of each sling and hoist.

(9) Extreme care is always taken in slinging heavy lifts. Slings should be blocked out with dunnage to prevent chafing and possible cutting. Place

dunnage between wire slings and metal to prevent slipping. In slinging heavy lifts, remember that shackles are stronger than hooks.

5. Stowage of Deck Cargoes.

a. Deck cargo usually consists of miscellaneous cargo for which there is no space under deck. These are dangerous articles, which, because of their size, nature, or shape cannot be readily stowed below deck. Because of the varying sizes and shapes of commodities stowed on deck, few specific rules for their stowage can be stated.

b. When stowing a large amount of cargo on deck, take care to avoid blocking off bitts and chocks, sounding pipes to bilges and ballast tanks, handles of valves of piping systems, or any other piece of equipment essential to the operation or safety of the vessel. It is a good practice to outline the spaces to be kept clear with chalk or paint.

C. Safety.

1. Securing Cargo Rigging. Shackles, hooks and gates of snatch blocks used in rigging should be moused with rope yarn or wire. In mousing a shackle, tighten the pin, then secure with rope yarn or wire. In all cases where rigging is aloft, use wire for mousing. Exercise care to place the mousing where it may not be cut by the wire rope made fast to the shackle. Hooks are moused to prevent the slings from slipping off the hook. Hooks may be moused with rope yarn, wire or a shackle. The gate of snatch blocks, unless firmly moused, may open, allowing the line to jump out. Before any operation, check all shackles, hooks, and blocks.

2. Working Below Decks.

a. The square of the hatch should always be kept clear and free of any debris, to reduce hazards that interfere with quick handling of cargo. After stowing in the square of the hatch a tier of cargo that does not provide sound footing, or which requires protection from cargo being landed, install a solid level floor of dunnage.

b. Crewmembers working in the hold should never stand in the square of the hatch when a load is overhead. For greater safety they should stand fore or aft of the square of the hatch.

c. When a load is lowered into the hold, stop it about one foot above the spot where it is to be landed. The cargo workers then come out from a place of safety and steady it while it is landed. They must never reach up for a load.

d. Dangers exist constantly while working cargo. Crewmembers must always be alert. Commanding Officers shall ensure that the following rules are adhered to:

(1) Wear personal protective equipment. Hard hats, steel toe shoes, safety gloves are mandatory.

(2) Be sure the load is properly slung before hoisting.

(3) Do not use worn-out gear.

(4) Never reach up for a load.

(5) Never ride a load or sling.

(6) Never stand in the bight of a line or wire.

(7) Never stand under a load.

(8) Never throw or drop anything between decks.

(9) Remember that shackles are safer and stronger than hooks, due to the reduced risk of coming unhooked.

(10) Stretch a life line around open deck hatches when not working cargo.

(11) Walk behind a load, never in front. Use the other side of the deck if possible.

(12) Watch out for swinging hooks, slings, and gear.

(13) When hoisting heavy loads, stand clear of all lines.

(14) When landing a load, never pull. Always push it in the desired direction.

(15) Illuminate hatches from inside at night.

D. Stability.

1. General.

a. The proper loading of a vessel is of crucial importance as it concerns the safety of the ship, its cargo, and its crew. Buoy tenders and boats, because of the nature of their assignments, normally carry considerable deck loads, so their crews must be particularly vigilant in ensuring safe loading. Vessel loading is one of the areas in which cutter personnel can directly affect their ship's stability. It is very important that commanding officers, engineer officers, and buoy deck personnel become familiar with the fundamentals of stability. This knowledge, together with information supplied in the Stability and Loading Data Booklet, should ensure that the vessel is properly loaded and seaworthy. This section is not intended to be a short course on stability, but it points out some basic stability definitions and information. Further information may be obtained from any of the standard texts on seamanship, such as *Knight's Modern Seamanship*. Commanding Officers should also review Chapter 079, Volume 1 of the *Naval Ships' Technical Manual* and *Stability and Trim for the Ship's Officers* by LaDage and Van Gemert, and be completely familiar with their vessel's Stability and Loading Data booklets.

b. Stability is the measure of a ship's ability to return to its original position when it is disturbed by a force and the force is removed. A ship may have any one of three different types of stability:

(1) Positive Stability. If the ship returns to its original position after being disturbed by an external force, it is stable, or has positive stability.

(2) Negative Stability. If the ship continues in the same direction of the disturbing force after the force is removed, it is unstable, or has negative

stability.

(3) Neutral Stability. If the ship settles in the orientation it is placed in by the disturbing force, it is neutrally stable. Neutral stability seldom occurs on a floating ship. If it does occur, extreme care should be taken not to exert any heeling force on the ship, because in all likelihood it will cause the ship to capsize.

c. To understand the principles governing stability you must first understand the principle of buoyancy. When a ship is placed in water, it displaces a volume of water, the weight of which is equal to the weight of the ship. The displaced water exerts a pressure on the hull, tending to force the ship back out of the water. This upward force is buoyancy. The resultant buoyant force acts in a vertical line through the center portion of the ship's body. This point is called the center of buoyancy and is designated by the letter B in **Figure 7-4**. B is a function of the ship's underwater body shape and volume, and is not easily affected by the crewmembers.

d. Countering the force of buoyancy is the weight of the ship and its cargo. Though the weight of the ship is distributed throughout the ship, it is considered to act through a single point. The point through which this resultant force acts is called the center of gravity, and is designated by the letter G. The weight of the ship also acts in a vertical line, but in a downward direction (see **Figure 7-4**). The center of gravity of a ship is solely a function of weight distribution within the ship. The center of gravity is in a fixed position for each condition of loading of the ship. It moves whenever there is a weight addition, removal or movement within the ship.

e. When a ship is in a position of equilibrium, the force of buoyancy and that of gravity are of equal magnitude, but acting in opposite directions. A ship may be disturbed from its state of equilibrium by a number of external forces that tend to heel it. These forces include those generated by shifting cargo; by free surface from flooding; or from fluids such as fuel and water shifting in tanks, wind, wave motion, current, icing conditions and the speed of the cutter through the water. When an external force is applied, the centers of buoyancy and gravity are no longer aligned vertically and these forces tend to rotate the ship, until a new position of equilibrium is found (positive stability) or until the ship capsizes (negative stability). These external forces exert heeling moments on the ship that may be short-lived or may last indefinitely. A stable ship does not capsize when subjected to normal disturbances because when it is inclined, the center of buoyancy shifts to one side of the center of gravity, creating a moment that tends to right the ship. This is called the righting moment (see **Figure 7-5**). The distance, GZ, between the parallel lines of force passing through G and B, is called the righting arm. When the righting arm is reduced, perhaps by added topside weight, the moment moving the cutter back into equilibrium is lessened and the stability of the cutter is reduced.

f. The metacentric height, GM, is the distance between G and the metacenter, point

M. The metacenter is an imaginary point that is of prime importance in stability. When a ship is inclined small angles, the intersection of the line or action of the buoyant force acting vertically through the new center of buoyancy and the inclined centerline of the ship is the metacenter. For any angle of heel, GM is proportional to the righting arm, GZ. When M is located above G, GM is positive and a righting moment exists **(Figure 7-6a)**. In those cases where the position of G is above M, GM is negative and an upsetting arm develops (**Figure 7-6b).** Thus GM is an indicator of whether a cutter's initial stability is positive or negative.

2. <u>The Stability and Loading Path Booklet</u>.

   a. With the above information, personnel can refer to the Stability and Loading Data Booklet for their cutters to obtain advice on the safe loading parameters for the ship and, should damage occur, advice on obtaining assistance for surviving that damage. The booklets are drafted for each cutter class, and although the same basic information is presented for all ships, the booklets vary considerably in format. What follows are brief explanations of key sections of the stability booklets. A basic understanding of these areas should give personnel knowledge enough to recognize potential problems before they arise. Commanding Officers are to familiarize themselves with the peculiarities of their class booklet, and know how to enter the unique characteristics of their cutter, so they can receive the most accurate information possible. Thorough study of the booklet until all sections are completely understood is required.

   b. The booklet's general or introductory remarks and the loading instructions are of interest, as they address particular class problems and issue special warnings when necessary. Weight constraints are of special concern to buoy tenders. Many Commanding Officers have unknowingly hazarded their vessels by carrying more tonnage than their ships were designed for, or by carrying weights in the wrong position, thus radically shifting the ship's center of gravity.

   c. Exercise care in lifting weights with the ship's boom. Do not assume that it is always safe to lift any weight less than the boom's maximum capacity. The way that the ship is already loaded, and its roll while underway, will have a bearing on what weight may be lifted safely without causing excessive heel or having an adverse effect on the ship's reserve stability and righting arm. The WLB stability booklet contains a Lifting Capacity Curve that determines the maximum load that a tender should attempt to lift, in any loading condition.

   d. The WLB booklet, and to a lesser extent those for some of the smaller classes, gives specific guidelines as to how the cutter's liquid load should be carried. Unfortunately, liquid loading is another subject that is given little thought, even though it is critical to stability. A study of the liquid loading instructions will ensure that this load is carried properly. All ships should make it a general rule to keep free surface effect to a minimum. While the design of cutters precludes keeping tanks pressed up, shifting water and fuel may be used to maintain trim and at the same time reduce free surface effect. The effect of the moving weights

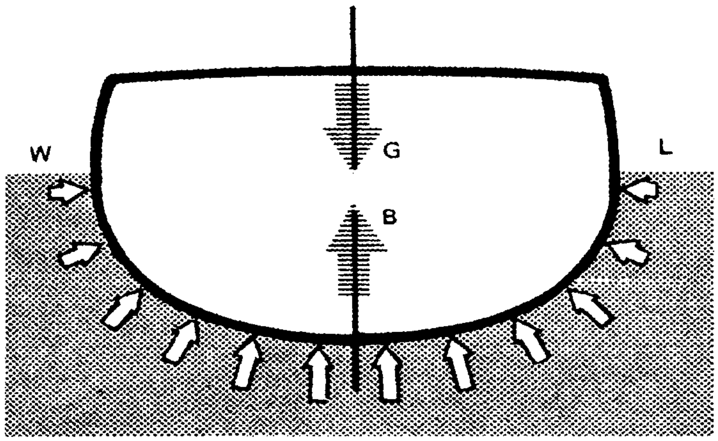
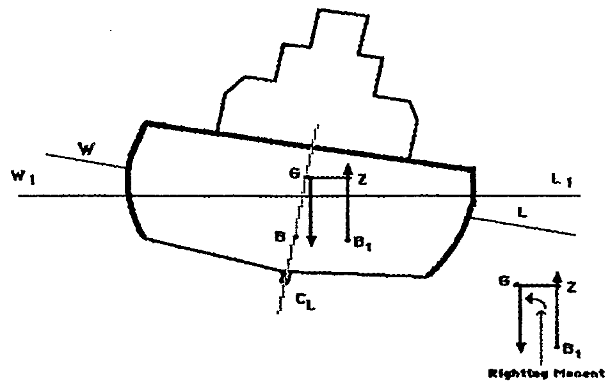
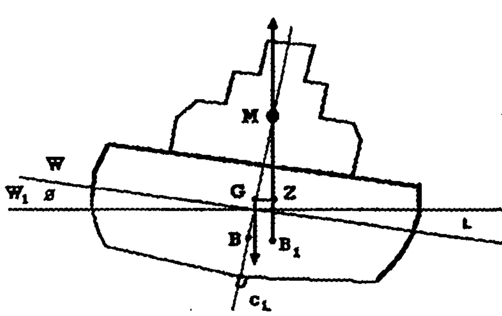


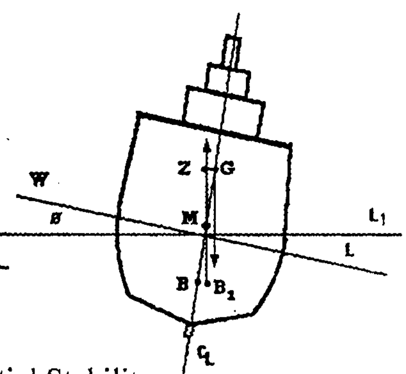
Fig. 7-4 Relationship of buoyancy and gravity centers



Waterline, Righting Moment Present, Ship Inclined

Fig. 7-5 Righting arm diagram





GM Indicating Initial Stability
Positive / Negative

Fig. 7-6a Vessel in stable condition

Fig. 7-6b Vessel in unstable condition

e. brought about by free surface can result in a substantial reduction of GM. This means a reduction in stability and it should be avoided.

f. Commanding Officers should be aware of their cutter's Minimum Operating and Full Load conditions, which are presented in tabular form in the stability booklet. Although not corrected in the strictest sense, these conditions can be thought of as the minimum and maximum safe loading conditions. Serious stability problems can arise if a ship is operated outside these defined loading conditions.

g. Draft and trim have considerable bearing on cutter stability. A change in mean draft will affect the height of the metacenter, thus altering, GM, and both draft and trim affect the cutter's reserve buoyancy. Safe operating parameters are listed in the stability booklet. Limiting Trim Diagrams, shown in Figure 7-5, are presented in most stability booklets. Although at first look these graphs can be quite confusing, they merely show a range of drafts and trims within which a cutter will have sufficient reserve buoyancy, even if flooded in various compartments.

h. The Limiting Trim Diagram defines a region of drafts and trim within which the reserve buoyancy will be sufficient. By consulting the Limiting Trim Diagram before sailing, Commanding Officers can adjust the cutter's trim by ballasting or by shifting deck load, fuel or water, so it will plot within the graph's safe shaded area. Maintaining cutter condition so that it always plots within this shaded area may be the ideal, but it is recognized that this is not always possible. Commanding Officers must be aware of the threat to their cutters when heavily loaded and must be prepared to take steps to improve their stability should problems arise.

i. Predicting changes in trim due to adding, deleting, or shifting weight about the cutter, is done by using the stability booklet's Trim Table. The table consists of a simplified profile view of the ship with a graph below the various compartments that indicates how much a standard weight placed in that space will affect draft. For example, in **Figure 7-7** we see that if a 133' WLM loaded 2.5 tons into the forward hold, the draft change would be determined as follows:

   (1) The Trim Table shows that a 5-ton addition to the forward hold would increase draft forward by 2.1 inches and decrease draft aft by .5 inches. Since the weight in the example is one half of the standard 5-ton weight, the change in drafts will be one half of the charted change, or an increase of 1 inch forward, and a decrease of .25 inches aft. Trim will change .75 inches down by the bow.

   (2) You must remember that this table is based on additions or removals of weight. If an existing weight is shifted, subtract it from its old position, then add it in its new position if an accurate determination is desired.

i. The change in the vertical center of gravity (KG), is another important measure of vessel stability. The maximum and minimum KGs for a certain cutter have been determined by the designer and personnel must ensure that these limits are not exceeded. The Change in KG Diagram is a tool used to assist in this effort. The Change in KG Diagram (**Figure 7-8**) is used to determine the effect of KG of adding (or removing) a weight at any height. Although the graph was developed using a weight of 10,000 lbs., it is applicable to any weight. To use this diagram, locate the VCG of the added weight on the ship profile, move horizontally across the intersect with the appropriate load condition line. Move vertically down and read the change in KG. For weight removed, reverse the sign of the change in KG. Add this value to the ship KG to find the new KG.

j. An important diagram is the Limiting KG Diagram (**Figure 7-9**). The Limiting KG Diagram present the upper limits of the vertical center of gravity (KG) to ensure the cutter has adequate transverse stability and does not capsize in either intact or damaged conditions. KG, the distance from the keel to the center of gravity, is directly proportional to GM, and is another good measure of stability. The allowable KG diagram assumes several cases of severe damage and then determines the maximum KG the vessel can have and still have sufficient stability. A WLB is reasonably safe as long as its KG plots below of applicable damage condition curves.

k. No one is interested in stability until their ship is holed. While stability may be a confusing subject, it is of the utmost importance. As the buoy tender fleet grows older and assumes more varied tasks and has additional equipment installed, proper understanding of these basic principles becomes critical. Commanding Officers owe it to their cutters and crews to be knowledgeable in this field. Thorough familiarity with the vessel's Stability and Loading Data Booklet and applicable sections of the *Naval Ship's Technical Manual* is required.

3. Corrective Procedures.

a. Recognizing a Reduced Righting Arm. The signs of a reduced righting arm, or GZ (**Figure 7-5**), and a subsequent loss of righting stability are:

(1) A long, slow roll compared to that which would be ordinarily expected for the wind and sea conditions.

(2) The cutter's hanging at the end of a roll without quickly snapping back to an even keel.

(3) The longer and slower the roll, the greater the danger of capsizing.

b. Reducing the Danger of Capsizing. Having loaded the cutter "good and deep" is not an indication of adequate stability. To reduce the danger of capsizing, weight must be removed high in the cutter, or weight (but not free water) must be added low in the ship. One preventive measure is to keep all scuppers unplugged. This will reduce weight high in the ship by allowing water on deck to quickly drain off. Another preventive measure is to keep all watertight doors and hatches securely dogged to prevent water from entering the cutter and finding its way to the bilges, increasing the free surface effect.

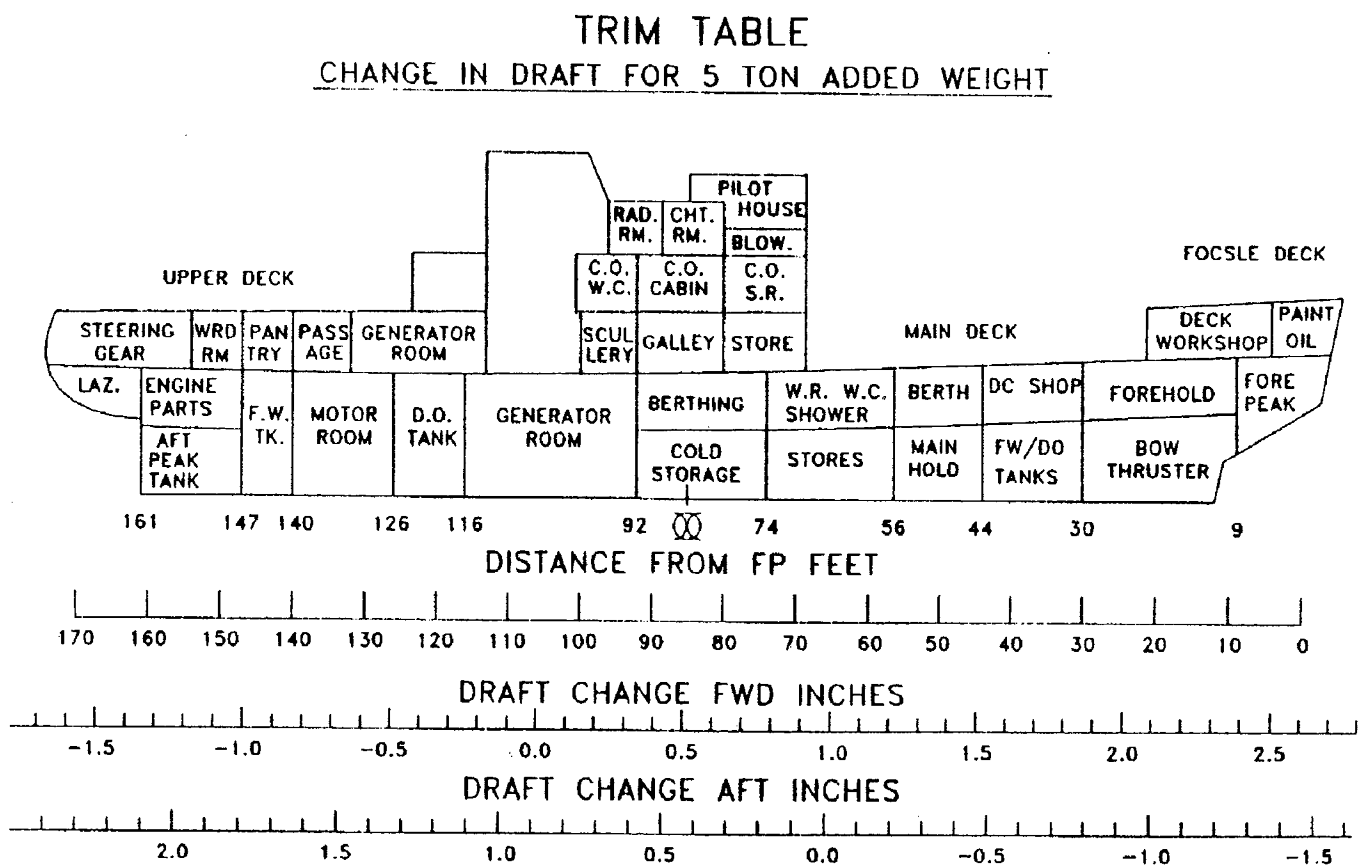


Fig. 7-7 Typical trim table

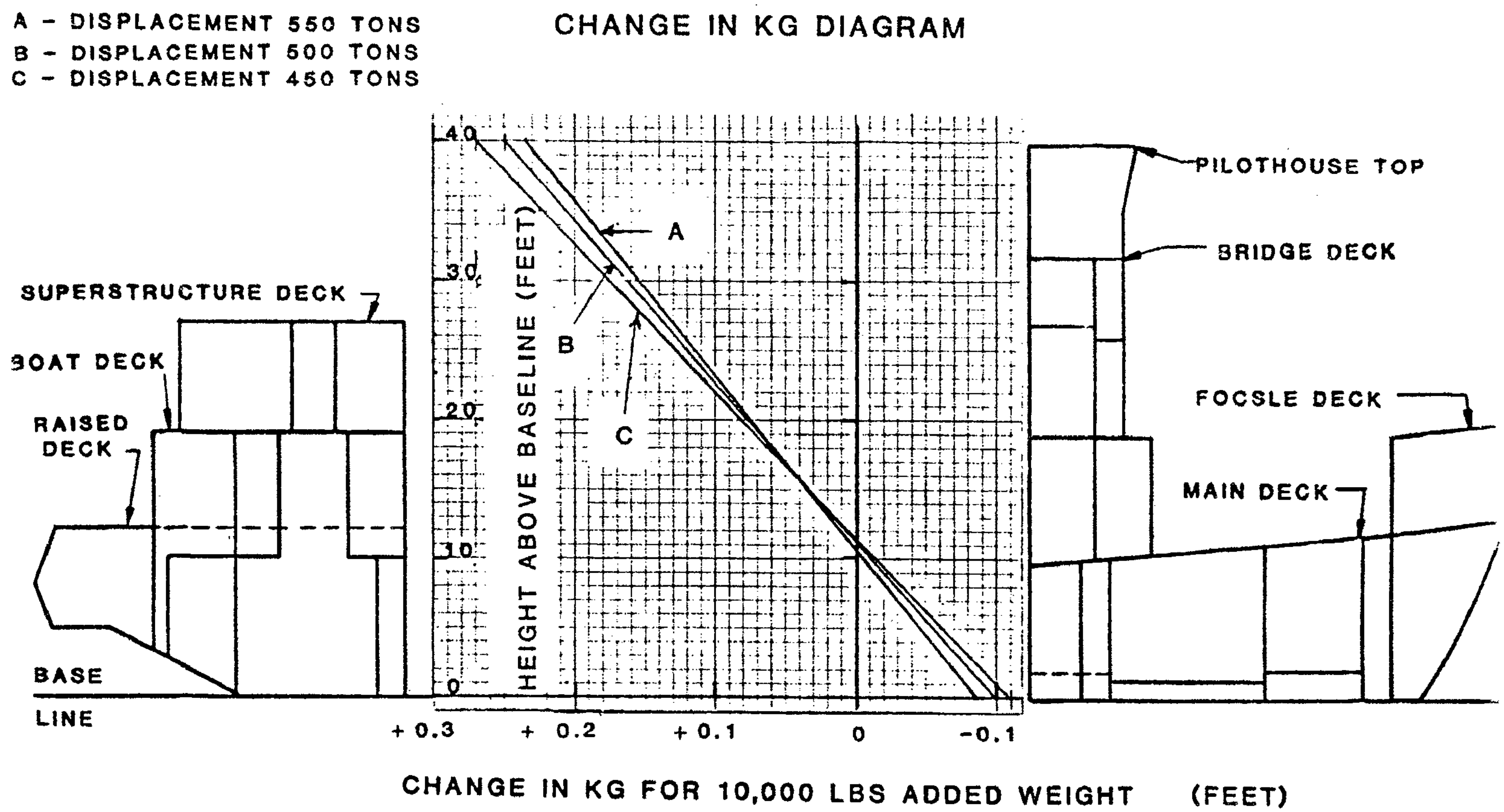


Fig. 7-8 Change in KG diagram for 157' WLM

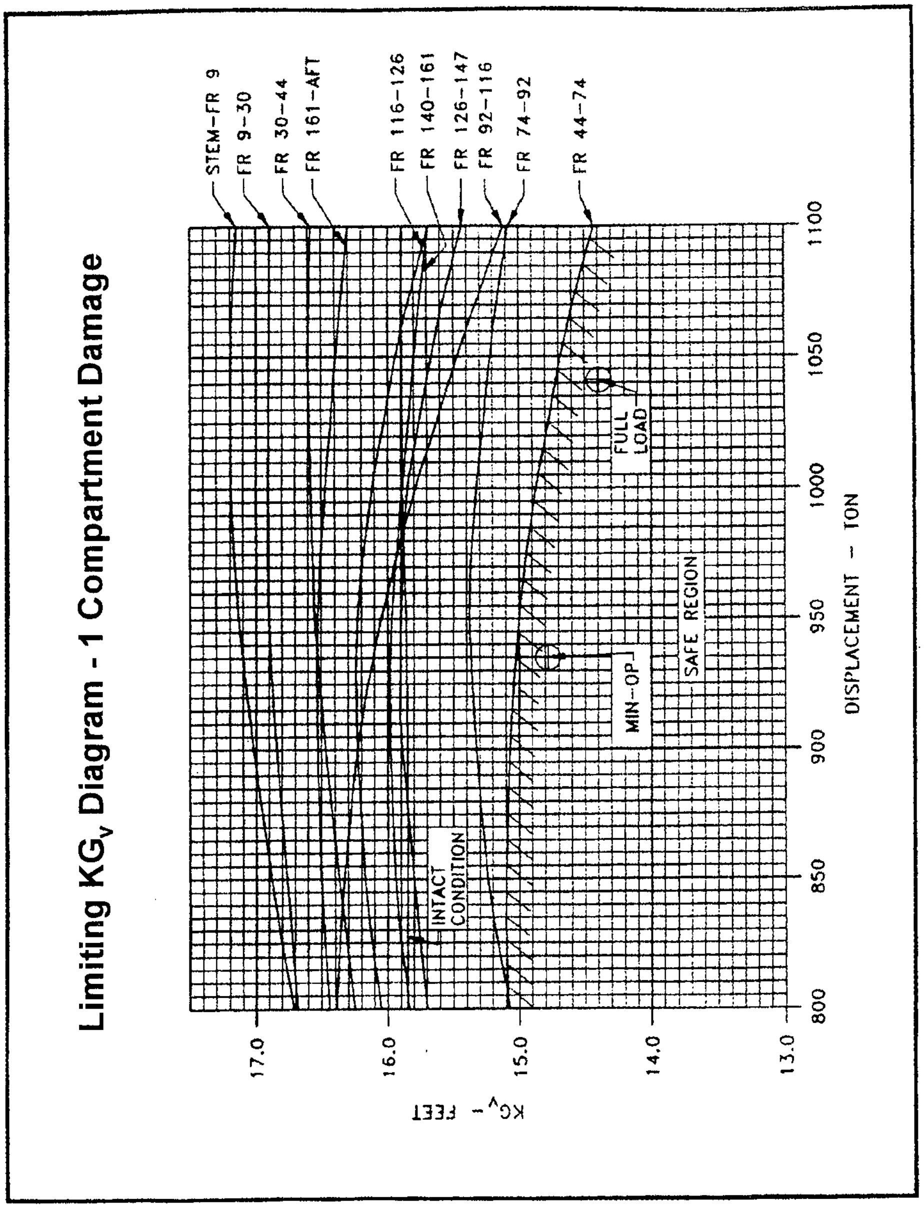


Fig. 7-9 Limiting KG Diagram

CHAPTER 8: WLB AND WLM BUOY HANDLING PROCEDURES

A. Loading and Stowing Aboard Tenders.

1. General. Careful planning is necessary to ensure that sufficient aids to navigation gear is on board to meet the requirements of a particular deployment.

   a. Buoy tenders normally carry a standard inventory determined by their aids to navigation (AtoN) responsibilities and their stowage capacity. This inventory is carried to enable the buoy tender to respond to unplanned AtoN work.

   b. In addition to the standard inventory buoy tenders will need to load AtoN gear for particular deployments. Normally, the first lieutenant prepares a load list which anticipates the buoys, appendages, and AtoN equipment needed for the trip.

   c. Flashers, lampchangers, batteries, etc., require bench testing before using them in the field to ensure their proper operation. Refer to the Short Range Aids to Navigation Servicing Guide (COMDTINST M16500.19) for specific requirements.

2. Preparations and Planning.

   a. The loading plan is developed from input by the Commanding Officer, Operations Officer, Engineer Officer, First Lieutenant, and other members of the deck department. The plan is based on ship stability and the sequence in which buoys are worked. If you know the ship will be doing a certain relief first, you can have the buoy in the ready position as opposed to stowed in one of the pockets. Make up a list of buoys, chain, sinkers, shackles, swivels, batteries, lanterns, paint, spare equipment, etc., needed for the trip. Plan where the load is to be placed on board to facilitate the work in the field.

   b. The First Lieutenant shall conduct a preloading brief for the deck department. Also, it is advisable to inform the other departments before beginning the loading operation.

   c. Before loading make sure all the necessary gear (i.e., buoy saddles, head blocks, gripe down gear, tag lines, etc.) is properly staged.

      (1) The amount of chain and sinkers necessary to accomplish work scheduled for the trip may be found from the aid records maintained on board. This record should list the sinker size, length of the mooring, chain and chafe size, date of last service, date of last mooring inspection, character of the bottom, etc. The work sheets, when properly maintained, provide an excellent history of the aid station. These will help significantly in planning maintenance. It is also helpful to compile a notebook over the course of succeeding visits to aids. Include information about the objects in the area, tides, currents, and anything else that will ease planning and logistics. In most cases it is not necessary to carry all new chain and sinkers for all buoys to be worked. Worn sections of chain can be cut out be reused.

d. Conduct a daily inspection.

(1) Check all buoys and equipment thoroughly before leaving the dock. Bench test all the lanterns and lamp changers, with a few extra of each characteristic, before sailing for a reasonable period to insure reliability.

(2) Install the lanterns on the buoys early enough to insure they are functioning properly. A final quality check should be made at this time. This should make sure that the installation was done properly and the correct characteristic and lamp size used.

3. Preparation for Loading.

a. In preparing to load buoys, appendages and equipment, carefully inspect the hoisting tackles, chain slings, wire rope straps and slings, snatch blocks, tools, etc., (see **Chapter 2**.) Keep the deck clear of stray lines, loose tools, and other gear.

b. Beginning with and maintaining a clean, organized deck will help to keep the evolution safe. Lay out the blocking chocks, or saddles for the buoys in the positions in which it is planned to secure the buoys. Having regard for the location of available padeyes for griping down (see **Fig. 8-1**.)

4. Loading Precautions. Observed the same precautions that are used in handling heavy weights in general. Keep the load low and move it slowly. Keep personnel out from under or between weights. Keep head and tail lines attached to weights; be prepared to snub them around a cleat, bitt, or padeye to keep the load under control. Make sure that the strap or sling is adequate before using it. Refer to the *Rigging Manual* or *Handbook for Riggers* to calculate proper sling size for the intended load. When hooking on buoys, check carefully that the hook is moused before hoisting. Shackles are better than hooks on slings for hoisting buoys aboard. Use only authorized slings designed to lift the weight. Pay close attention to sling angle and the safe working load (SWL) of slings.

5. Loading Unlighted Buoys.

a. For loading buoys in a horizontal position, a double branch or two-legged sling is used.

b. One leg of the sling is generally shorter than the other. This long end is hooked in the mooring eye on the counterweight end of the buoy and the other in the lifting bail.

c. A sling with two 12-foot legs is used for loading first class buoys. Buoys equipped with balancing bails may be hoisted on board by hooking the hoisting tackle directly into the balancing bail. This is located just below the middle of the buoy.

d. SLING ANGLE DANGERS. Increasing sling angles decreases the sling's capabilities. Refer to standard sling size tables and sling angle diagrams in the riggers handbooks.

6. <u>Stowing buoys in the hold</u>. When loading buoys for stowing in the hold, pick them up at one end only. Use a short strap or shackle rather than hooking directly into the lifting bail. If a short strap is not used, the sling may be passed completely through the lifting bail and hooked back into its own lifting ring. A buoy hooked directly is liable to become unhooked should the strain be eased, as when the buoy rests momentarily on the deck or on top of another buoy. Therefore, the hook should be moused. When stowing buoys in the hold, use a light tackle to haul the buoy over to any desired position, while the boom holds most of the weight. As the buoy is moved, slack off on the whip as appropriate.

7. <u>Loading Lighted Buoys</u>.

   a. Before lifting a lighted buoy clear of the dock, attach a headline (or cage line) and a tail line. The headline should be rove through the lamp ring of the cage and a tail line attached near the counterweight. Members on the dock tend these lines to prevent the buoy from swinging. The end of the headline is passed to members on deck, as the buoy is hoisted on board to maintain control. This will help to transfer control smoothly to those on deck.

   b. Conical bottom buoys, pillar buoys, and tube buoys (especially the larger type), are better handled by a two-legged sling. Attach the sling into one lifting padeye and one mooring padeye. This will carry the buoy horizontally or nearly so and will assist in positioning the buoy in the saddle. Flat-bottom buoys are best handled with a two-legged sling of equal lengths, attached to the lifting padeyes. This carries the buoy vertically and makes for easier positioning on deck, having two legs of equal length flat-bottom buoys.

8. <u>Loading Equipment and Appendages</u>.

   a. When loading batteries, take to care prevent broken cases and terminals during handling. If palletized batteries are loaded using a pallet sling, the load must be secure so none can fall during handling.

   b. Sinkers are loaded by hooking the appropriate purchase directly into the bail of the sinker.

   c. Chain is loaded in bundles of one or more shots secured with a line or wire strap. Bridles are similarly handled.

9. <u>Fundamentals of Stowage</u>.

   a. Because of the variety of sizes, shapes and weights of buoys, each presents a slightly different stowage problem. The important factor in securing the load is to use sufficient gripes of ample size and lead them in the proper directions to prevent movement. The weight of the object and angle of the gripes should be checked in a riggers manual against the SWL table to insure the griping equipment is equal to the task. Never overload the buoy deck. Leave sufficient space on deck for working personnel and equipment. Buoys <u>**shall**</u> be blocked and griped even in calm weather. The list of the ship under a heavy load may start the deck load shifting in a seaway. Never land lighted buoys or sinkers directly on steel decks. Landing buoys and sinkers on dunnage prevents sliding and also facilitates washing down the decks. Locate buoys and appendages clear of bitts, cleats, and scuppers. All buoy saddles and headblocks shall have tag lines attached of sufficient length (minimum 6'). This will prevent personnel from having to get under a buoy to position them. Always gripe the deck load as soon as it is in position on deck. Do not wait until everything is on board before griping.

b. When only a short distance is involved between the dock and the working area, buoys may be stowed in the way of the buoy ports, ready for setting. Because of the possibility of unexpected rough weather or a change of itinerary, make sure buoys and associated moorings are secured for sea. Rotten stops are designed to break under heavy load and are not a proper device to secure chain on deck.

c. When underway, you must inspect buoy gripes regularly to insure no change in tautness or shifting of the load. The movement of the ship can cause gripes to loosen; they require strict attention by watchstanders.

d. It is important that all buoys are properly secured. They must be prevented from moving both athwartships, and fore and aft. With inexperienced personnel there is a tendency to be content with only securing the buoy downward to the deck. The result is that the gripes lead almost vertically from the buoy and there is only frictional resistance to movement of the buoy along the plane of the deck. All loads must be secured so opposing gripes prevent fore and aft and sideways movement of the load. It is better to spend time for adequate securing before going to sea than to attempt the dangerous job of securing a shifting deckload (See **Fig. 8-2**.)

e. Tenders stow buoys and appendages in different places on deck, commensurate with the space available, the working plan, type of buoys carried for the trip, trim of the vessel, etc. No set rule of stowage can be laid down for different types of cargo. However, suggested procedures are given in the following paragraphs.

10. Stowing Unlighted Buoys. Small unlighted buoys may be stowed in the main hold where they are blocked and wedged securely against stanchions, cargo battens, bulkheads, etc. Gripe buoys with 2- or 3-inch line or herc-alloy chain of appropriate size, herc-alloy chain being the preferred product. Line may be used to secure light weight plastic or foam buoys but should not be used for griping down steel buoys. The use of manila line vice synthetic line is recommended due to the elasticity of synthetic ropes. The elasticity of the synthetic line may allow the load to work, despite the tautness of the gripe. The stretch of the line allows movement and the shock load of a moving object can easily exceed the breaking strength of the line.

11. Stowing Lighted Buoys.

a. Lighted buoys are placed on deck on head blocks, saddles, and other appropriate dunnage. The body of the buoy shall not rest entirely on the steel deck but must be supported by the dunnage. This allows weight of the buoy to bite into the saddle and increases the friction of the blocking. Lighted buoys are griped with

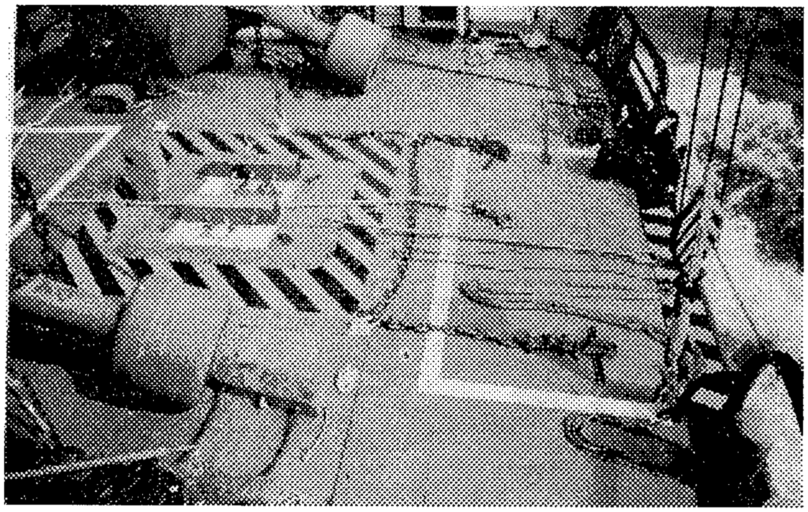


Fig. 8-1 Buoy deck layout when approaching a buoy

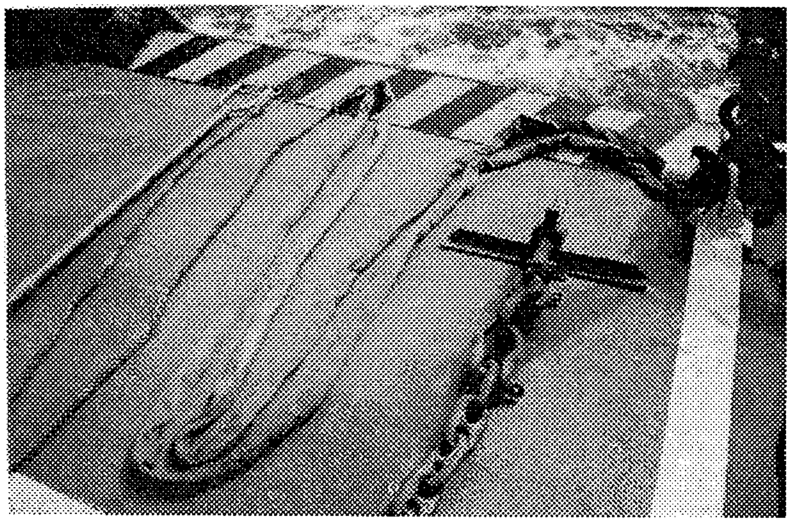


Fig. 8-1 continued Buoy deck layout when approaching a buoy

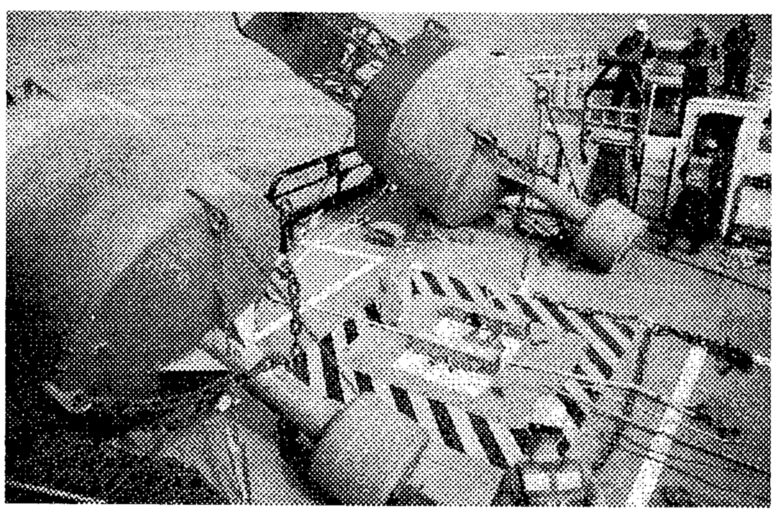


Fig. 8-2 Griped down buoys

Note: in Figure 8-2, only one gripe chain is shown. This is incorrect procedure.

alloy chain and steamboat jacks with an SWL large enough to hold the buoy being secured. Flat-bottomed buoys are stowed flat on deck on thin planking or plywood and are griped with alloy chain and steamboat jacks. Six- and eight-foot pillar buoys are usually stowed with the tube down, with a headblock under the middle of the buoy's upper body. The cages of lighted buoys must often be nested over and against each other to get them all on board. A gripe is passed through the bottom bail which is opposite the lifting bail. The standard method for griping down is to use four separate chains and steamboat jacks. The gripe down chains are attached using foundry hooks to the appropriate bails on the buoy. The chains are then led at an angle out, away from the buoy and secured to padeyes. This will prevent fore and aft and side movement. Each chain will also require a separate jack for tightening down.

b. Nine-foot buoys require particular care in blocking and securing due to size and weight. Two of these buoys are all that can be carried for working, although three can be squeezed aboard for transportation purposes. A minimum of six chain and steamboat jack gripes are passed to the body of the buoy. If necessary to place a gripe on the buoy tube, take a half hitch or round turn as close to the counterweight as possible. Extra care should be exercised when placing any gripes on or around the tube. The tension placed in the wrong point can crack or break welds connecting the tube to the buoy body. Gussets placed to strengthen these welds will not prevent this.

c. Moorings for 9-foot buoys are often ranged out on deck before loading the buoy, since once the buoy is in position, the buoy port area is largely blocked.

12. Stowing Appendages.

a. Generally appendages (i.e. sinkers, chain, and bridles) are stowed forward on the buoy deck, to utilize every available space on deck. They can also be stowed in the hold or in some cases under the cage of the buoys, depending on available griping points on deck. Chain is generally stowed in bundles and secured. Sinkers are landed on small equally-spaced wood dunnage and chain should be appropriately lashed. When carrying an unequal number of lighted buoys, sinkers you may want to place to trim ship.

b. Keep on hand enough steamboat jacks, various shackles (safety shackles should be used instead of split key shackles), and lengths of chain for griping down. Alloy chain (minimum grade 7) in sizes 1/2" to 1" is usually strong enough for most loads. When in doubt, consult a riggers manual.

13. Saddles and Headblocks. The use of saddles and headblocks is mandatory. Various sizes are in use and their quantity and variety of size depend upon the aid inventory of the cutter (See **Figures 8-3a to b**.) These saddles will accommodate most standard and non-standard buoys. However, good documentation of the idiosyncrasies of buoys will help in planning for the next evolution. Extra bails, improperly placed bails, or lack of bails may affect how the buoy sits in a saddle. It is unrealistic to carry saddles designed for every style of buoy that may be encountered. Therefore, be prepared to modify existing equipment for the exception.

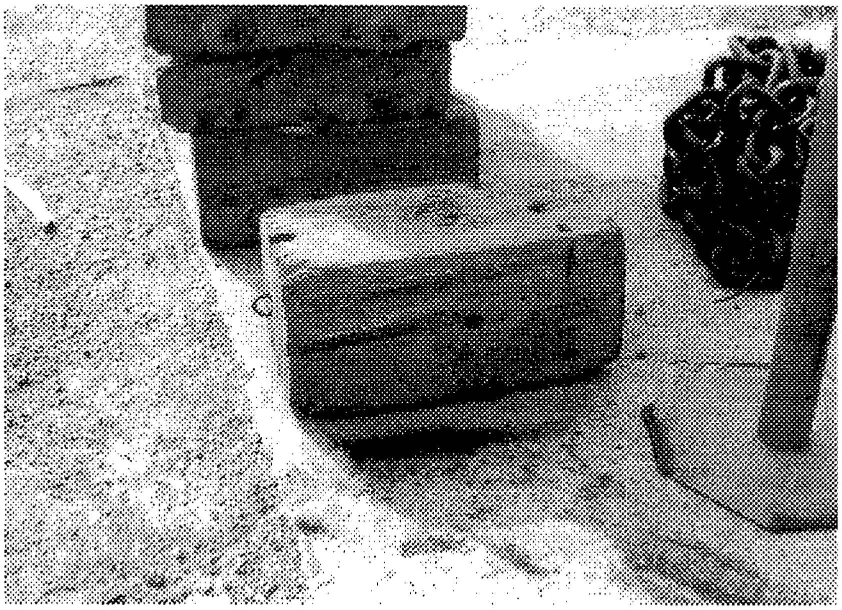


Fig. 8-3a Headblock

Fig. 8-3b Wood saddle

B. The Buoy Mooring.

1. Planning.

   a. As conditions permit, position the sinker as close to the deployment buoy port as possible, thus reducing the distance you have to move it when setting up the mooring.

   b. Ensure that all the necessary gear is staged before beginning to set up the mooring, i.e., hammers, shackles, rotten stops, etc.

   c. Rig an alloy bull chain fore and aft between the first two padeyes inboard of the deployment buoy port. Use alloy shackles of sufficient size to secure the bull chain to the padeyes.

   d. Rig two pelican hooks. Shackle one at the forward end of the buoy port, close to the chain stopper. It will act as a safety measure if a chain stopper fails. Shackle the other pelican hook at the after end of the buoy port. This one helps prevent shock loading the boom and also acts as a preventer when setting the buoy.

2. The Chain.

   a. Shots and sections of chain used in buoy moorings are joined with rivet pin (heat and beat) shackles (See **Figure 8-4**.) The size of the shackle depends on chain size and its proof load. Use shackles that have proof loads equal to or greater than the largest size chain it is connecting. Consult the Aids to Navigation Technical Manual (COMDTINST M16500.3) to determine the proof loads of buoy chain and shackles. The following are procedures are used when using rivet pin shackles:

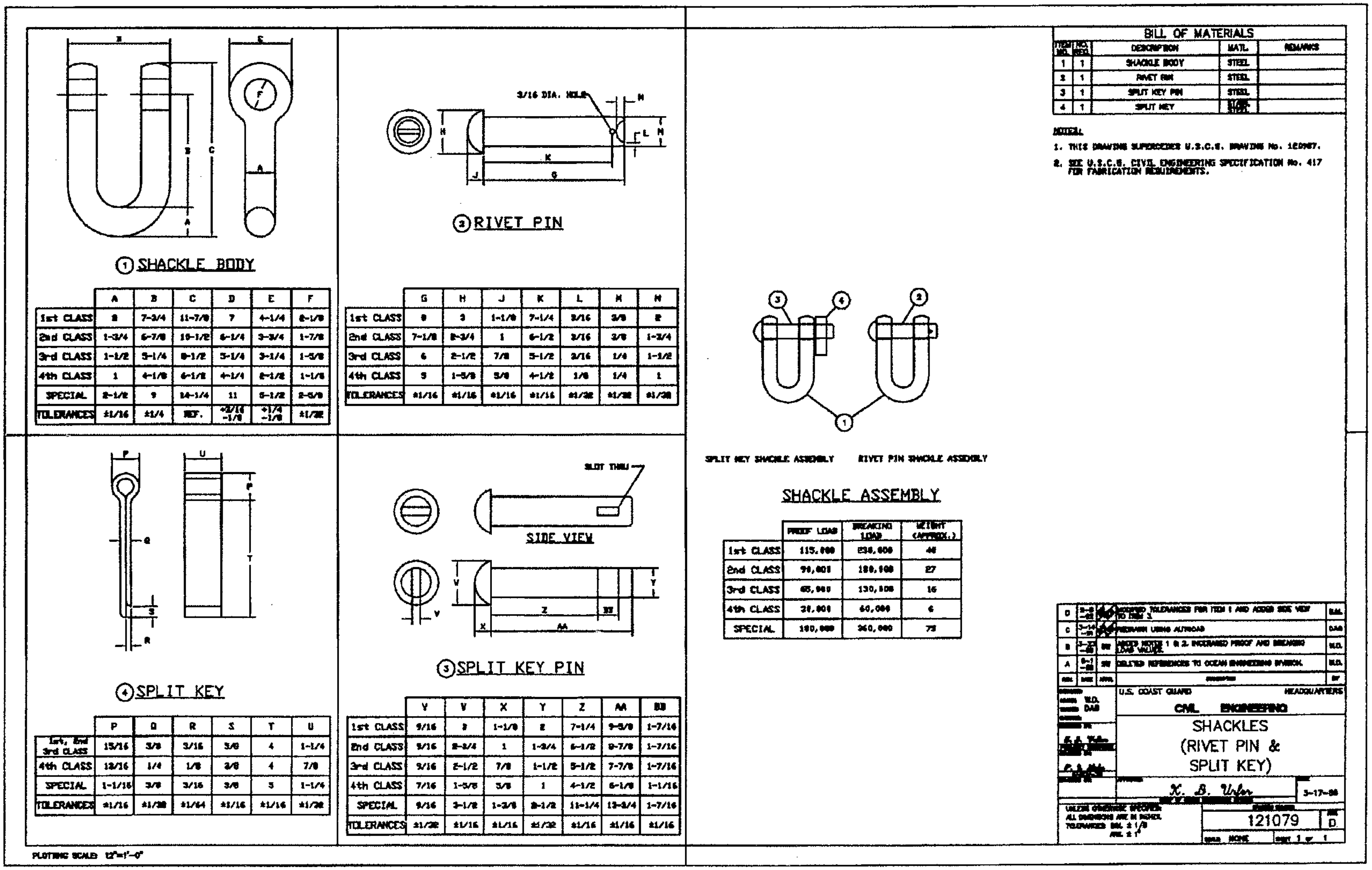
      (1) Avoid placing rivet pin shackles in the chafe section of the mooring.

      (2) Place the bow or clevis of the shackle into the chain coming from the buoy. The pin surface bears on the chain coming from the sinker. This lessens the possibility of the shackle getting fouled with the chain stopper horse collar when the mooring is retrieved.

      (3) Place the heat and beat anvil over a frame to give it a more solid foundation.

      (4) Position the person peening the shackle facing outboard, and located where they will have the most control and balance. If more than one person is peening the shackle, position them at or as near 90 degrees apart as possible. Two persons peening a shackle should not be positioned directly across from each other. Always have a clear escape route for the torch person.

      (5) Do not overheat the pins as they may become too brittle. At no time should molten steel appear. If the shackle is heated to the point where molten steel appears, the shackle should be removed from service.



① SHACKLE BODY

	A	B	C	D	E	F
1st CLASS	2	7-3/4	11-7/8	7	4-1/4	2-1/8
2nd CLASS	1-3/4	6-7/8	10-1/2	6-1/4	3-3/4	1-7/8
3rd CLASS	1-1/2	5-1/4	8-1/2	5-1/4	3-1/4	1-5/8
4th CLASS	1	4-1/8	6-1/2	4-1/4	2-1/2	1-1/8
SPECIAL	2-1/2	9	14-1/4	11	5-1/2	2-5/8
TOLERANCES	±1/16	±1/4	REF.	+3/16 -1/8	+1/4 -1/8	±1/32

② RIVET PIN

	G	H	J	K	L	M	N
1st CLASS	8	3	1-1/8	7-1/4	3/16	3/8	2
2nd CLASS	7-1/8	2-3/4	1	6-1/2	3/16	3/8	1-3/4
3rd CLASS	6	2-1/2	7/8	5-1/2	3/16	1/4	1-1/2
4th CLASS	5	1-5/8	5/8	4-1/2	1/8	1/4	1
TOLERANCES	±1/16	±1/16	±1/16	±1/16	±1/32	±1/32	±1/32

④ SPLIT KEY

	P	Q	R	S	T	U
1st, 2nd 3rd CLASS	15/16	3/8	3/16	3/8	4	1-1/4
4th CLASS	13/16	1/4	1/8	3/8	4	7/8
SPECIAL	1-1/16	3/8	3/16	3/8	5	1-1/4
TOLERANCES	±1/16	±1/32	±1/64	±1/16	±1/16	±1/32

③ SPLIT KEY PIN

	V	W	X	Y	Z	AA	BB
1st CLASS	9/16	3	1-1/8	2	7-1/4	9-5/8	1-7/16
2nd CLASS	9/16	2-3/4	1	1-3/4	6-1/2	8-7/8	1-7/16
3rd CLASS	9/16	2-1/2	7/8	1-1/2	5-1/2	7-7/8	1-7/16
4th CLASS	7/16	1-5/8	5/8	1	4-1/2	6-1/8	1-1/16
SPECIAL	9/16	3-1/2	1-3/8	2-1/2	11-1/4	13-3/4	1-7/16
TOLERANCES	±1/32	±1/16	±1/16	±1/32	±1/16	±1/16	±1/16

SHACKLE ASSEMBLY

	PROOF LOAD	BREAKING LOAD	WEIGHT (APPROX.)
1st CLASS	115,000	230,000	46
2nd CLASS	90,000	180,000	27
3rd CLASS	65,000	130,000	16
4th CLASS	30,000	60,000	6
SPECIAL	180,000	360,000	73

BILL OF MATERIALS

ITEM NO.	NO. REQ.	DESCRIPTION	MATL.	REMARKS
1	1	SHACKLE BODY	STEEL	
2	1	RIVET PIN	STEEL	
3	1	SPLIT KEY PIN	STEEL	
4	1	SPLIT KEY	[illegible] STEEL	

NOTES:

1. THIS DRAWING SUPERCEDES U.S.C.G. DRAWING No. 120987.
2. SEE U.S.C.G. CIVIL ENGINEERING SPECIFICATION No. 417 FOR FABRICATION REQUIREMENTS.

Fig. 8-4 Rivet-pin shackle

(6) Be careful when peening smaller shackles (usually 4th class) as excessive force will deform the shackle clevis.

b. Range the chain athwartships, from fore to aft, each bight running from just inside the deck edge to the bull chain. Place a bight of chain at each end of the mooring into the pelican hooks. Locate the pelican hooks about 3-4 fathoms from the bitter end nearest the chain stopper, and 4-6 fathoms from the bitter end nearest the buoy. This will allow enough chain to hook and hang the sinker and buoy. Depending on the size of the mooring, use up to 21 thread manila for lashing (rotten stops) the individual bights to the bull chain

c. After the sinker is hung, replace the tie-downs with rotten stops. The rotten stops, sized to part under the weight of the mooring, will check the chain's speed going over the side. They are not used to gripe chain to the deck. The line size used for rotten stops is determined by the size and length of the mooring. Six thread or a strand of 21 thread is good for rotten stops for 1-1/2" chain and larger. Although rotten stops should part under the weight of the mooring, station a crewmember with a long handled ax or knife, inboard of the bull chain, to cut away any rotten stops that fail to part.

d. With an exceptionally long mooring, the chain is often stacked in layers. Always begin faking stacked chain from the buoy end to the sinker end. Do not stack chain on top of synthetic line risers. Make sure that the bights of chain and synthetic line will not become entangled when the mooring is set. Also, when deploying a long mooring use a line stopper, placed close to and forward of the after pelican hook. The stopper helps reduce the shock loading on the pelican hook. The line stopper is cut once the chain has run to the pelican hook.

3. <u>The Sinker and Buoy End of the Mooring</u>.

a. If necessary, move the sinker to the deployment buoy port and gripe it to the deck. Shackle a bight of chain, 3 to 5 links from the end nearest the chain stopper, to the sinker bail. (See **Figure 8-5**.) Ensure that the bow or clevis of the shackle bears against the sinker bail and that the shackle pin passes through the chain link. **Do not shackle the bitter end of the chain into the sinker bail. Always leave a chain pigtail of 3 to 5 links to facilitate removing the hook once the sinker is hung in the chain stopper.**

b. The mooring attachments on all lighted and sound steel buoys are designed for an equal leg bridle. Consult the *Aids to Navigation Technical Manual*, COMDTINST M16500.3 to determine the correct size bridle to use). The bridle is connected to the buoy with split key shackles. On lighted buoys with counterweight tubes the center ring of the bridle should rest about the center of the counterweight. On buoys with a chafe block, they rest against the block. Make sure there are no twists or kinks in the bridle legs. Split key shackles are also used to connect the swivel to the bridle center ring and to the riser section of the chain. Install the shackle connecting the center ring to the swivel with the rounded end of the shackle pin against the counterweight (or chafe block).

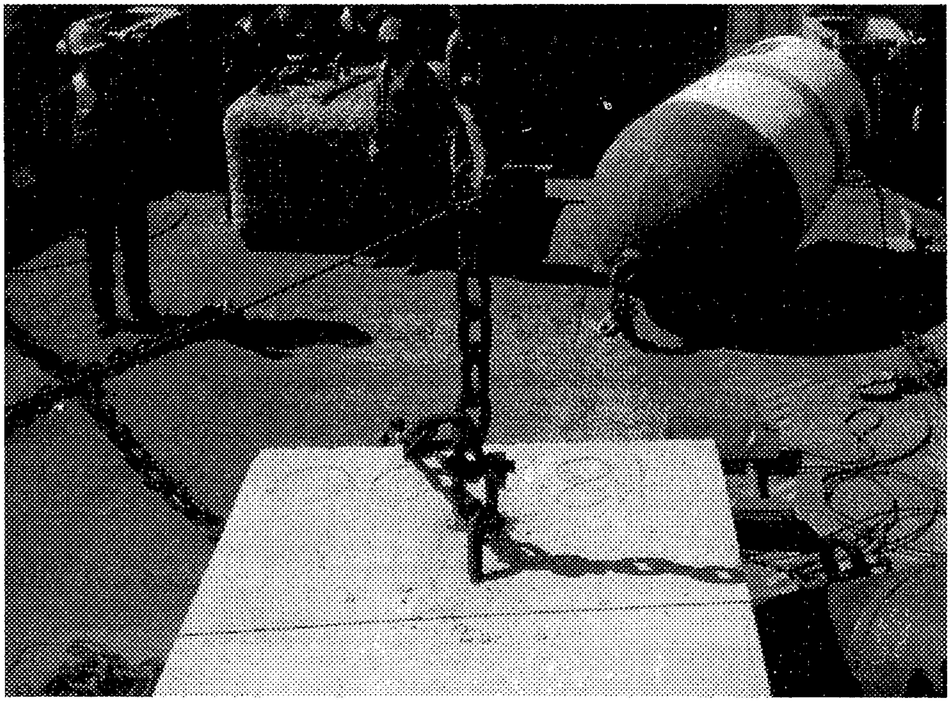


Fig. 8-5 Mooring shackled to sinker

c. Flat-bottom lighted buoys are equipped with swing arms. The bridle is connected to them using split key shackles. Install the shackles with the rounded end of the shackle pin against the counterweight. This improves access to the split key both for connecting and disconnecting.

d. The swivel is connected with the eye end toward the bridle center ring and the bail end toward the chain. Install the shackle that connects the swivel to the chain with the pin through the chain link and the clevis contacting the swivel bail.

e. The unlighted steel buoys are designed with a mooring attachment point at the bottom of the counterweight. Some versions also have a fast water mooring fin along the side of the counterweight. There are three types of attachments: an eye, a box and pin, and a bail. All the buoys manufactured after 1991 have the eye attachment. The eye and box and pin attachments are designed to use a separate split key shackle as the mooring bail. A second split key shackle is used to attach the swivel and a third to connect the riser chain to the swivel. The pin on the box and pin attachment replaces the shackle's pin. The bail attachment is self explanatory.

f. Where unlighted sound buoys are subject to icing, a preventer may be rigged to prevent the buoy from capsizing. A sufficient length of 7/8 or 1-inch chain is run through the bridle ring and both ends are secured to the bottom eye of the buoy. The chain is adjusted to permit the buoy to rock on its bridle up to a certain point. Past that point, the full strain of the mooring shifts to the bottom of the buoy and prevents the buoy from capsizing.

C. The Buoy Deck Evolution.

1. General. Servicing a floating aid to navigation from an unstable buoy deck is always a hazardous operation. Each buoy brought aboard will, no doubt, present a slightly different situation, depending upon any combination of sea conditions, weather conditions, length of chain, size and type of buoy, experience of the conning officer, experience of the deck crew, fatigue level, etc. Considering these factors, if the crew is trained to work every aid using a standard procedure, the evolution is safer and more efficient. The buoy deck evolution listed below has been adopted as the required Coast Guard standard method for servicing buoys. The specific buoy deck evolution will be discussed as it relates to WLB class tenders followed by variations based on other buoy tenders.

2. Planning and Preparations.

a. Convene a briefing session before beginning any buoy deck operation. The Commanding Officer/Officer in Charge, Conning Officers, First Lieutenant (Safety Observer), and Buoy Deck Supervisor should all be present at the brief. The brief should include, at a minimum, the following topics:

(1) Type and number of buoys to be worked.

(2) Length and size of chain expected and bottom condition.

(3) Local peculiarities for each buoy.

(4) Ship conning intentions on approach and hoist.

(5) Communication procedures between the bridge and the buoy deck.

b. Convene a similar briefing with the buoy deck crew before arriving at the buoy. Assign jobs and answer questions during this briefing.

c. Clear the buoy deck of all unnecessary gear. Lay out buoy saddles, head blocks, gripe down gear, cross deck and hogging lines, hammers, marlinespike, etc.

d. Inspect and exercise the boom. Test all power driven deck winches to ensure their proper operation. After inspecting and exercising the boom, spot (position) it so the purchase being used is slightly inboard of the buoy port opening. Never leave the hook unattended. Once the hook and boom are spotted at the desired location, the hook should be run into a deck padeye until ready to hook the buoy.

e. When all is ready the Buoy Deck Supervisor informs the conn that the deck is ready.

4. The Approach. Shiphandling is covered thoroughly in Chapter 5. It is important for the buoy deck supervisor to know how the conning officer will approach the buoy. Normally, a buoy is approached from down current or down wind, whichever has the most effect on the ship. When the buoy is approached from down current/wind the bridle and chain will tend forward. On most lighted buoys the lifting bail that is most forward will be the correct one to hook.

5. The Lift.

a. When the conn has maneuvered to the buoy and is maintaining a steady position, the conn will pass to the buoy deck, "Hook the buoy when you can." The Deck Supervisor now has permission to bring the buoy on board.

b. On most buoys, the first step after receiving permission to hook the buoy is to pass the cage or head line.

(1) The cage line is passed from a point forward of the chain stopper. On buoys 8 foot and larger the fo'c'sle is the ideal location from which to pass the cage line.

(2) The cage line is rove through the lantern ring opening opposite the desired buoy lifting bail. Feed the line through the lantern ring until there are two equal lengths. The bitter ends of the cage line are then taken to a cleat forward of the chain stopper.

(3) The cage line serves two purposes: 1) it helps rotate the buoy to facilitate hooking, and 2) it helps control the buoy's travel down the side of the ship.

c. Once the buoy is at the desired position alongside the buoy port the hook is rove into the lifting bail. A line reeving device greatly facilitates this operation. Devices such as the "happy hooker" can be bought commercially, or one can be manufactured locally based upon drawing FL-2604-5.

(1) On lighted cone bottom and pillar buoys the hook is rove into the odd bail.

(2) On most flat-bottom lighted buoys the hook is rove into one of the bails that are 180 degrees apart. (Note: this holds true for all flat-bottom buoys manufactured after 1991.)

(3) On most sound and unlighted steel buoys the hooking bail is marked by the word "HOOK" welded on the buoy body next to the bail. (Note: this is applicable for sound and unlighted steel buoys manufactured after 1992.)

d. When the hook is set into the bail, hoist the buoy until the hull clears the water and the lifting bails are accessible from the deck. The hook is then moused by use of a tag line. The preferred method of mousing the hook is to figure eight the tag line, over the throat of the hook. **THE USE OF MECHANICAL MOUSES ON HOOKS OR SECURING THE FIGURE EIGHTS WITH A WEATHER HITCH IS STRICTLY FORBIDDEN.** If a picking pendant is used instead of hooking directly into the lifting bail, the need to mouse the hook remains. After the hook is moused, the buoy port safety chain is removed.

e. The cross deck line is rove after the hook is moused. Hoist pillar and cone style buoys until the hull just clears the buoy deck. This will allow the buoy to rotate inboard and facilitate hooking the cross deck. A line reeving device is used if the lifting bail is beyond the reach of the buoy deck. It also eliminates the need for personnel to go under the load to hook the cross deck into the buoy. The cross deck is used to establish partial athwartships control of the buoy. There are two types of cross deck lines: wire rope and synthetic line. They are both rigged basically the same. An appropriate snatch block is rigged a to deck padeye adjacent to the opposite buoy port with a single leg section of alloy chain. The cross deck is led to the buoy port and rove to the appropriate bail. The cross deck line is always kept taut once a strain has been taken. The following are the recommended cross deck bails on the different type buoys:

(1) On lighted cone-bottom and pillar buoys the cross deck line is rove into the bail furthest from the odd bail.

(2) On flat-bottom lighted buoys manufactured after 1991, the cross deck line is rove into the bail opposite the hook. On flat-bottom buoys manufactured before 1991, the cross deck line is rove into the bail furthest from the hook.

(3) On sound buoys manufactured after 1991 and unlighted steel buoys manufactured after 1992, the cross deck bail is rove opposite the hook.

(4) On sound buoys manufactured before 1991, the cross deck line is rove into the bail furthest from the hook.

(5) On unlighted buoys manufactured before 1992, the cross deck line is rove into the top bail of the buoy.

f. The following are the recommended procedures for bringing the buoy on deck:

(1) The buoy is lifted until the bottom of the buoy hull clears the buoy port. The cage line is slacked and the cross deck line is heaved around until the

buoy is positioned athwartships.

(a) Flat-bottom buoys are lifted until the counterweight ring barely clears the deck.

(b) Unlighted buoys are lifted until the top of conical counterweight section clears the deck.

(2) With the cross deck line taut, the cage line is shifted to the opposite side of the ship. Two to three twists are put in the legs of the cage line to reduce the chafing and obtain more positive control. One leg of the line is led forward and the other is led aft. The two legs of cage line will control the buoy cage and keep it from swinging as the buoy moves across deck.

(3) The cross deck and cage lines are kept taut and the boom is kept with a slight outboard lead. The load is always kept close to the deck. In fact, the counterweight on tube and conical bottom buoys should never leave the deck. Counterweight rings on flat-bottom buoys leave the deck only long enough to clear the bull chain.

(4) Once the buoy is positioned at its approximate gripe-down point, the hogging line is hooked into the mooring chain. The hook is attached so it points upward to prevent it from catching on the chain stopper. The hogging line is hauled in to bring the chain into the chain stopper. The chain is seated in the chain stopper with a sledge hammer before removing the hogging line.

(a) The counterweight of a tube buoy is generally outboard of the bull chain when it's in gripe-down position. However, some tenders prefer to locate the buoy so the counterweight rests against the bull chain.

(b) The counterweight of a 9X38 buoy is generally left extended over the side of the tender and snubbed against the side of the buoy port when it's in the gripe-down position.

(c) Conical and flat-bottom buoys are generally positioned and griped down entirely inboard of the bull chain.

(d) Several WLM-133 class tenders only have one capstan, to work both the cross deck and hogging line, two lines are made up on the capstan. To hog the chain into the stopper, the cross deck is surged. Strict attention is required of the line handlers to prevent overriding turns. Generally, only two round turns are necessary of the hogging line due to the large size of the capstan.

(e) Tripping line. For flat-bottom buoys, especially 7x17, difficulty can be encountered in geting the buoy to stand up when set on deck. Dependent upon conditions it is possible for them to balance in such a manner that the hook will tumble and possibly unhook, regardless of being moused. The tripping line is rigged fore and aft with one end secured to a padeye, the other hand tended to a cleat with the line lying on top of the counterweight. Tension is applied to the line as the buoy is lowered. The tripping line will force the buoy to stand on its counter-weight, vice laying over.

g. After the chain is set in the chain stopper, the buoy is set on deck, griped, disconnected from the mooring, and serviced. The following are the procedures for securing a buoy on deck:

(1) The saddle and head block are already in the approximate gripe-down position. After the chain is set in the chain stopper the saddle is positioned, using the tag lines. Position the saddle so the chine of the buoy will rest in the middle of the saddle. The buoy is lowered and set in the saddle but a slight strain is kept on the purchase hook. Once the buoy rests in the saddle, the head block is slid into place and seated with a sledge hammer.

(a) On flat-bottom buoys a piece of plywood or wood planks are used in place of the saddle.

(b) Occasionally an obsolete round-bottom buoy may have to be brought on deck. An old tractor tire is the best saddle to use for these types of buoys.

(c) In instances where the buoy will remain in the slot only temporarily, an alternate griping method may be used. Once the buoy is set in the saddle and the head block set, the hogging line is run through a pear link located inboard of the stopper. A round turn is then taken around the buoy tube and the hook set into a padeye aft of the buoy (see **Figure 8-6**). The hogging line (tube gripe) is then hauled taught and held. The cross deck is left attached to the buoy and kept taught. Once all other parts of the particular evolution are completed the buoy is then moved to its final stowage location on deck.

(2) After the head block has been set, the buoy is griped down to the deck. Different buoy types, deck padeye locations, deck loads, and sea conditions create a myriad of griping possibilities. We will cover only a few of the more common gripe-down configurations here. Some simple rules to keep in mind will help in those more unusual griping situations: (1) Plan; always have a gripe-down plan before bringing a buoy on board. (2) Opposing forces; lead the gripes so they control the aft as well as the forward movement. (3) Keep the personnel out of harm's way; never place personnel on the buoy to accomplish the griping.

(a) Lighted tube and conical-bottom buoys are griped down with four separate lengths of chain. The chain should be grade 8 alloy chain or grade 7 transport chain and steamboat jacks. The working load limit of each gripe should equal the total weight of the buoy. Normally the tube gripes are set before the head gripes.

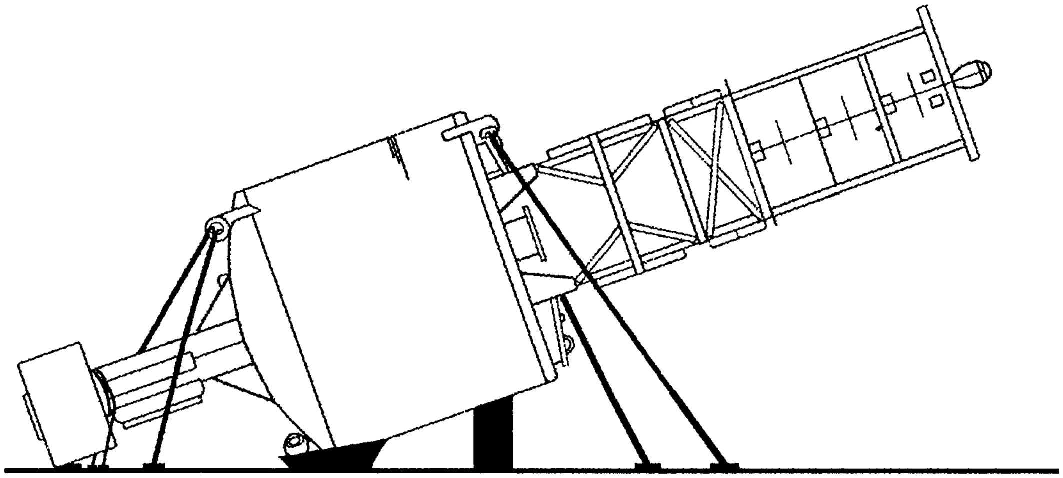


Figure 8-6 Buoy with a tube gripe

(b) Flat-bottom buoys are normally griped down with two separate gripes. Each gripe is formed in a "V," with each leg attached to a steamboat jack, which is connected to a padeye. The bight of the gripe-down chain is rove through or on the inside of the buoy lift bail. Additional gripes should be used if a transit in rough water is expected.

(c) Unlighted buoys are griped to the deck with a sufficient number of separate chains and steamboat jacks. Position the steamboat jack on the high side of the buoy when a gripe is run obliquely.

h. After the buoy has been properly griped down the mooring is disconnected from the buoy. The mooring is disconnected at the shackle that joins the swivel to the riser chain.

i. Whether relieving the aid, conducting a mooring inspection, or just doing a routine servicing, at some point you will need to pull chain.

(1) Before pulling the chain, install the horse collar in the mechanical stopper. This facilitates resetting the chain in the stopper. equal leg bridle. Attach a tag line to the bitter end of the chain, for control during pulling. On WLBs, a round turn about the boom cradle stanchion is used; on other class vessels an appropriately placed cleat may be used.

(2) For large size chain, the hook may be inserted directly into a chain link. For smaller sizes of chain either a safety shackle of appropriate size, a modeer shackle (preferred) or a nipper chain maybe used to connect to the chain.

(3) Spot the boom inboard of the chain stopper approximately 3-5 feet.

(4) When permission is received from the bridge, commence hauling. Exercise care in lifting the chain out of the stopper to prevent damage to the chain and/or stopper. Once clear, the chain can be pulled until the hook is nearly two blocked. The boom can then be slewed to continue pulling chain. The boom should not extend beyond the side of the ship on the opposite side.

(5) When the desired amount of chain is pulled, slew back towards the stopper allowing the chain to slip back into the stopper. It may be necessary to lower the hook and move the boom to change the lead on the chain. This will permit the proper angle of attack for it to fall back into the stopper. Once set, the chain is faked down by crewmembers and disconnected from the hook. This is continued until the desired length of chain has been pulled.

(6) Extreme caution must be exercised during this evolution. Until the sinker has been brought on board the chain remains "hot" or "live." No one should be allowed to get into bights of chain or stand outboard of it. The chain should be handled with chain hooks and not hands.

j. Once planned work has been accomplished it is time to reset the buoy and mooring. As with bringing a buoy on board, close coordination is required with the Conning Officer.

(1) If the sinker is on deck, begin by placing the sinker into the chain stopper. At least two points of control are required on the sinker when moving it. Hook the main or whip into the chain pigtail (this is necessary to allow the hook to be released after the chain is in the stopper). Hook the cross deck or similar line into the main chain approximately six feet above the sinker, or into the pigtail. Once complete control is established, remove the gripes.

(2) Depending on the location of the sinker, keep it on the deck and slide it as much as possible. If it must be picked up, keep it as low as possible to the deck that it can still clear obstructions. Once at the buoy port, take the sinker over the side and then draw it back against the hull. This provides additional control of the sinker. Then walk it into position just below the chain stopper. The mooring chain is drawn into the stopper and set with a sledge hammer. The strain is transferred from the main or whip onto the chain stopper and all hooks are removed.

(3) Connect the main (or whip), crossdeck and cage lines to the buoy, and mouse the main (or whip). Then connect the mooring to the buoy. Take a strain on all points before releasing the gripes. Lift the buoy just high enough to clear any obstructions and move it out and over the side. Once over the side, lower it until the buoy hull is even with the buoy port and draw the buoy up against the hull. At this point, shift the cage line to a cleat forward of the buoy port. Then, remove the crossdeck line; the buoy should rotate so the cage is forward. Walk the buoy aft until clear of the buoy port. This helps prevent the mooring chain from fouling or damaging the buoy when it runs over the side. Once the gripes are cleared from the buoy and all hands are clear, it should be moved immediately; ideally the buoy should not be stopped until it is over the side and resting against the hull. Stopping and starting the buoy while in the air will lead to swinging and delays the evolution during a very critical period. While not always avoidable, this should be kept to a minimum.

Note: An additional method of controlling the buoy while moving it to the buoy port is to attach a line to the tube near the counterweight. Some styles of buoys may have a lug located in the bottom of the counterweight which may also be used for attaching the line. This line is removed just before the buoy goes over the side.

(4) At this point conditions may warrant the rigging of a preventer. This is particularly important on WLB 180s because of their vang design. Rig the preventer by lowering either the main or whip (whichever is not in use) and connect it to a deck padeye, then taking the slack out. The rig design on the WLM 157s will not allow this due to their self leveling design on the whip. This design would in fact turn the whip into a topping lift and begin

raising the boom.

(5) The mouse is removed from the hook, and the buoy deck supervisor makes a final inspection of the deck arrangement. Upon command from the bridge, the chain stopper is tripped. Once the chain has fetched up on the after pelican hook, the buoy is set and the hook cleared away. With the buoy clear of the buoy port, the aft pelican hook is tripped and the last bight of chain allowed to run over the side. As the buoy moves forward, the cage line is then released and pulled aboard.

D. Special Evolutions.

1. <u>Fouled Mooring Chain</u>.

a. Hoisting kinked, knotted, or fouled chain aboard can be a very dangerous procedure. It requires ingenuity and patience to get the fouled mooring aboard without injuring anyone or damaging gear. Pelican hooks, nipper chains, and wire rope slings are often employed to bring a fouled mooring aboard. Immediately advise the conn when a fouled mooring is sighted. Be aware that a mooring may be fouled with a sunken buoy or other objet that could exceed the lift capacity of the boom.

b. Kinked mooring chain often occurs in areas of rotary current or when the buoy swivel is not operating properly. It will begin as twisted chain and if left long enough will develop into a knot. Sometimes a kink will clear itself as it is being hoisted aboard or if the mooring is dragged a short distance by the ship.

c. Generally there are three ways in which a knot in mooring chain may develop. The knot may develop from twisted or kinked chain. It may happen when the bottom chain wraps around the sinker. Finally, it could happen when the mooring chain becomes fouled with something other than itself. When bringing a knotted mooring on deck always be alert for a sudden slipping or unraveling of the chain. It may become necessary to place the chain in the chain stopper or a pelican hook and let it be dragged a short distance by the ship. A nipper chain may be attached to the chain below the knot and a second purchase hooked in as soon as possible (See **Figure 8-7**.) A mooring can become fouled from a myriad of sources. Normally, if the chain has not kinked or knotted, whatever has fouled the mooring is removed. If the mooring is already knotted or kinked, use the guidance in the above paragraphs.

d. Buoys without lifting eyes. Recovering unlighted nuns and cans whose padeyes have been damaged or carried away can be easily accomplished with the use of a lasso. A lasso (see **Figure 8-8)** is a wire rope sling with one eye lashed to the hook on the main or whip and a running eye formed in the other end. After the tender pulls alongside the buoy, boat hooks are used to place the lasso over the buoy. The hook is then lowered allowing the lasso to travel below the buoy. The hook is then raised cinching up on the lasso. The lasso will take hold of the mooring just below the buoy and as it is raised will pick up the buoy upside down. The buoy is then brought on board. Because the buoy is upside down, control on

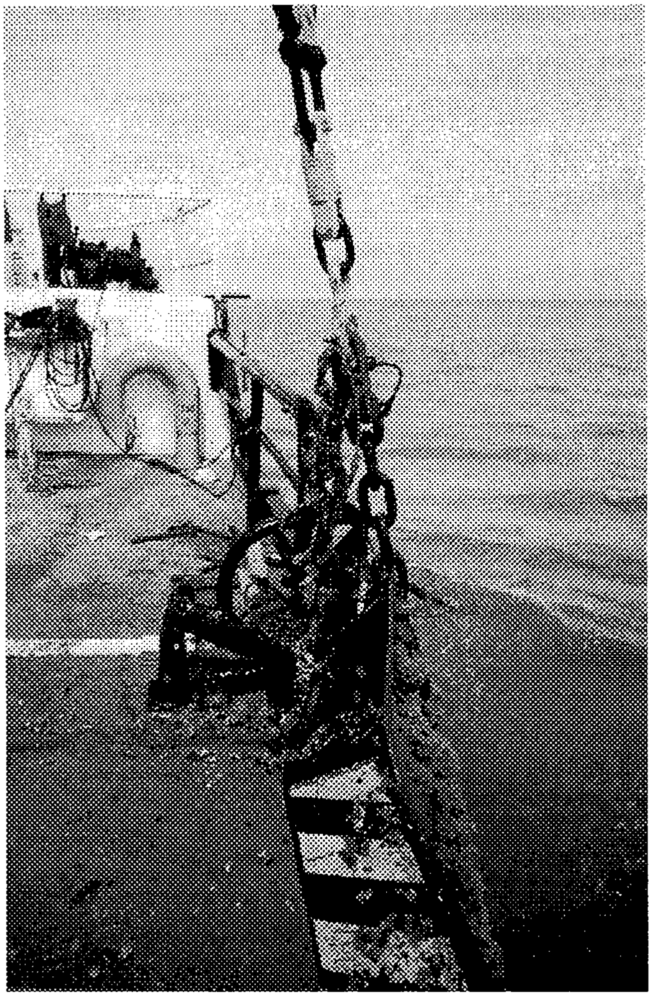


Fig. 8-7 A knotted mooring

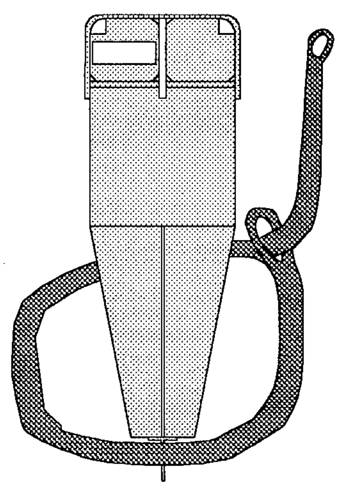


Figure 8-8 Lasso

deck is very limited and extreme caution must be exercised. The mooring chain is then hogged into the stopper, lasso disconnected, mooring disconnected and buoy stowed on deck. This method is particularly useful where wintermarks are used or where ice damage occurs.

Note: The Buoy Deck Supervisor and Safety Observer MUST be alert. As the lasso comes taught the hook will have limited room before it fouls the king sheave on the boom.

Note: The lasso should not be used as a choker around the buoy body due to the potential for slipping. Ensure that the lasso tightens around the chain.

E. Physics of Handling.

1. General.

a. Most Coast Guard vessels that handle aids to navigation and other cargo operate with a single boom. The boom is moved from side to side, describing an arc, by rigging called vangs. Vangs attached to the vessel at the deck level move the boom only in a horizontal direction. Vangs which are mounted on opposite corners of the superstructure, such as the bridge wings, are capable of moving the boom horizontally, vertically, or a combination of the two. With either type of arrangement, horizontal movement is done by hauling in one vang and paying out the other.

b. Low-mounted vangs cannot move the boom up or down. Vertical movement of the boom is accomplished by separate rigging called the topping lift. The vangs and topping lift operate independently with a different source of power for each system. Movement of a boom which has a topping lift is done in a horizontal, then a vertical direction, or vice versa- not in both directions at once. If different power sources are used, horizontal and vertical movement is difficult to coordinate. Instead of low-mounted vangs, the WLM tenders use a pinion gear for horizontal movement of the boom. Pinion gears are easily damaged by side loading. No topping lift is necessary for the boom supported by high-mounted vangs. There are three ways to maneuver the vangs to produce any type of boom movement. For vertical movement of the boom, move both vangs in the same direction at the same speed. For horizontal movement of the boom, move the vangs in opposite directions at the same speed. For both vertical and horizontal boom movement, move the vangs at dissimilar speeds, either in the same or opposite directions.

2. Moving buoys.

a. It is not always practical to move a buoy in a horizontal position. Therefore, it is essential to understand what happens when a buoy is lifted by one of the top padeyes.

b. The boom must be topped in the correct position in relation to the center of gravity. On buoys with a tube and counterweight, the center of gravity is well below the center of the buoy body. Refer to the paragraph 8-16 on tripping lines for flat-bottom buoys.

c. If you top the boom over the center of gravity as shown in **Figure 8-9a**, you will encounter difficulties. While the buoy is lying stationary on the deck, it is in equilibrium. The force of the boom on the buoy is a force vector as shown in the illustration. The buoy will move up because of the vertical component of that vector. There is also a comparatively large horizontal component, so the buoy will tend to move to the left (in the illustration) as well. However, the toe of the buoy is exerting a frictional force to the right, as indicated. If the toe of the buoy is wet or covered with marine growth, the frictional force will be less than if it is dry. So, while the buoy is attempting to move to the left, the friction of the toe against the deck will hold it back and the buoy will move mainly upward. When the buoy is high enough, the horizontal component of the force of the boom will overcome the friction, and the buoy toe will skid across the deck.

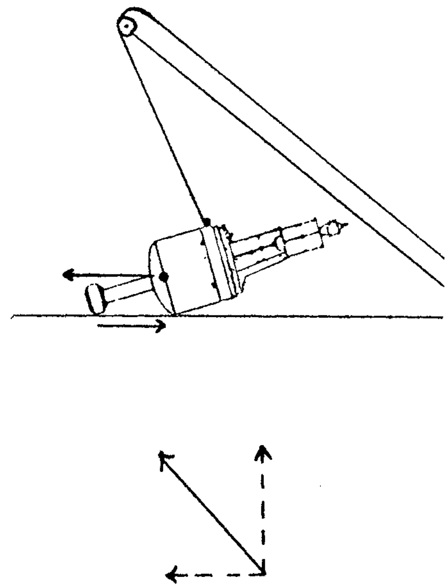
d. Obviously, this method is not satisfactory. Now let's look at what would happen if we topped the boom over the lifting eye (See **Figure 8-9b**.) In this case, the force of the boom has a vertical component only. This looks good, since there's no horizontal component to move the buoy sideways. We're overlooking the center of gravity, trying to move under the boom. In this case, the friction of the toe is working to the left, because now the buoy is trying to move to the right. As soon as the tendency of the center of gravity overcomes the force of friction, the buoy will go skidding to the right, with the same undesirable results as before.

e. The solution to this is only a partial one. The following procedures will reduce the sudden, violent movements of the buoy, but will not eliminate them entirely. Top the boom over the lifting eye. As you begin to raise the whip (or whichever rig you are using), move the boom toward the point over the center of gravity of the buoy. Thus, instead of allowing the buoy to move its center of gravity under the point of the lift, you will move the point of the lift over the center of gravity. Thus you will raise the buoy keeping in essentially the same position on deck and will retain control of its movements. Remember you cannot completely overcome the friction forces and in fact there are instances, because of how you must stow the buoy on deck that, and boom angle limitations you cannot spot the buoy in the desired position. Therefore it is mandatory to place other controls on the buoy in order to maintain positive control of the buoy.

3. Boom limitations on WLB/WLM.

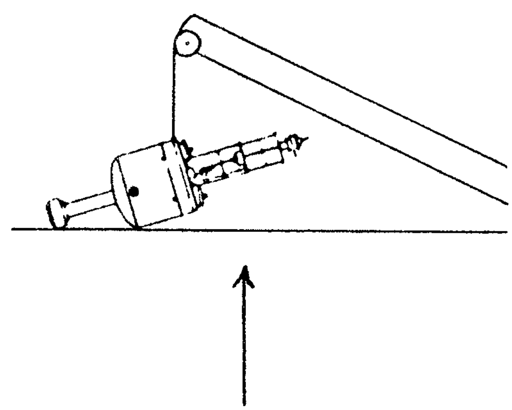
a. The following parameters have been established for the WLB-180 and WLM-157 and 133 class vessels.

Vessel Class	Topping:	Slewing
WLB 180	60 degrees	70 degrees
WLM 157	65 degrees	90 degrees
WLM 133	70 degrees	75 degrees



Components of the vector
representing the force of
the boom

Fig. 8-9a Boom over center of gravity



Force of boom

Tendency of center
of gravity

Fig. 8-9b Boom over lifting eye

b. When moving loads from onto and off the ship, the effect the load has on the ship must be considered and planned for. As a strain is taken or relieved from loads they affect the list of the ship, the arc the load will travel when slewing the boom and the height of the boom end above the surface, be it water, a pier or the buoy deck. The following diagrams example describes the effect of heel on hook position:.

Situation: A buoy is being loaded or offloaded from a pier. As you take a strain on the buoy the load will not initially rise; instead the ship will heel to that side until the righting arm of the vessel exceeds the weight of the buoy. At that point the buoy will begin to lift. As the load is slewed onto the deck the ship continues to right itself. The height of the buoy above the deck decreases until either the load is raised or contact is made with the deck. Experience with raising or setting heavy loads will allow supervisors and boom operators to spot the boom in an appropriate position to compensate for the change in ship heel.

F. Unloading Buoys and Appendages.

1. General. Many of the same procedures described for loading can be followed in unloading. Before buoys are unloaded they should be inspected, any defects noted and marked so repairs may be made. Space the large buoys on the dock to permit sufficient working room around them. Ensure that the buoys are safely and securely blocked before leaving them. Maintain a close liaison with the base about the placement of buoys ashore.

2. Preparation of Buoys and Appendages before Turning In.

   a. Buoys should be cleaned of marine growth. The bridle, batteries, and lantern hardware and solar gear must be removed. Tenders should scrape marine growth before returning to port. It is far easier to scrape marine growth off a buoy soon after pulling it out of the water, than to wait until it is dry. Waiting may require that sandblasting methods be used to remove the growth.

   b. Batteries should be removed from buoys before off-loading. **Consult Commandant or District Commander manuals for proper disposal of batteries.**

   c. Usually the bridle is reusable, so it is unshackled, scraped and washed off for storage. Even if it must be disposed of, remove it from the buoy before off-loading.

   d. Chain that has been removed from moorings should be turned in to the appropriate local facility for disposition. Follow the procedures outlined in the Property Management Manual, COMDTINST M4500.2 (series) and local implementing instructions.

   e. Sinkers removed from service should be marked to prevent mistaken reuse, and disposed of in compliance with local directives.

G. Towing Buoys Back on Station.

1. General.

   a. Buoys are sometimes found off station. Normally, the servicing tender will place the buoy on deck to reset on station. Occasionally, it may be necessary to drag or tow a buoy to station. This is especially necessary if the servicing vessel is incapable of lifting the weight of the buoy and/or mooring.

   b. Towing buoys by hooking on the hoisting tackle of the boom shall not be attempted.

2. Towing Buoys in Good Weather.

   a. Before approaching the buoy rig up a short length of chain with a hook on one end. Do not use buoy chain. Splice a tripping line to the eye on the back of the hook. Using a line reeving device, hook on to the buoy's lifting lug and then drop the other end of the chain into a pelican hook. It's never a good practice to tow (drag) from the chain stopper.

   b. Increase engine power slowly until the mooring chain is felt to be fully stretched. Greater power is then applied to break out the sinker. Increasing power too rapidly once slack is taken up may cause undue stress on the mooring. This is particularly true if secured to a well sanded-in sinker. The result may be parting the mooring chain with the resultant loss of chain and sinker. If there is any difficulty in breaking out the sinker, it may be worked free by taking a strain in various directions.

H. Recovering Buoys Sunken or Washed Ashore.

1. Grapnel Drag for Sunken Buoys.

   a. All tenders are called upon from time to time to drag for sunken buoys. Most vessels have large cumbersome grapnels (anchorhawks) weighing 400 to 500 pounds. The weight of the grapnel makes it necessary that the ship itself tow and handle the grapnel in combing the area. This is a slow and tedious process, many times ineffective because of the presence of a shoal area nearby, which can restrict the movements of the ship. For 6 x 20 lighted buoys or smaller, a specially designed grapnel weighing about 100 pounds has been used. This can be handled entirely from a small boat, which because of its maneuverability can comb in a much shorter time.

   b. Providing the buoy has sunk on station and weather conditions permit, and the work is carried out systematically and thoroughly, the grapnel should hook the buoy. The most common fault is that the grapnel is towed too fast, thus causing it to hop along, touching the bottom only occasionally. Towing too fast can be dangerous in a small boat. If the grapnel should hook into something suddenly, it may pull the stern of the small boat down and swamp it.

   c. In dragging for a sunken buoy, place a few marker buoys to outline the area, or track on position grid. The first five to seven passes should be perpendicular to the current direction. If no results are obtained, the area should be crisscrossed.

d. When using the heavy grapnel proceed as follows: Use 1-1/8 to 1-1/2 inch chain depending on the size of the buoy to be recovered, shackled to the grapnel. The scope of the chain should be at least three times the depth of the water. Shackle the inboard end of the chain to a padeye on the deck and drop the grapnel over the side, using the chain stopper. Next lift enough chain to put a bite in a pelican hook on deck. Then unshackle the bitter end from the padeye and set it in the chain stopper. Have way on the ship, otherwise the chain will pile up on top of the grapnel and foul, becoming useless. With the grapnel on the bottom and the ship going ahead slowly, hook a cross deck line into the section of chain leading from the pelican hook over the edge of the buoy port. Fairlead it to the anchor windlass. Keep three or four turns of the line on the gypsy head of the windlass until the sunken buoy or chain is hooked. This will be immediately noticeable, as the additional strain will cause the line to surge on the gypsy head. Keep a forward strain on the chain with the ship until you are sure the grapnel is securely hooked in. Haul the chain aboard (See **Figure 8-10**.)

e. Often the grapnel makes contact with the sunken aid or moorings, but fails to engage them. One way of improving the probability of catching the chain is to modify the grapnel flukes. A slotted web between the fluke and shank acts as a chain stopper in grabbing the links of mooring chain as they pass over the fluke. The distance between angle plates and depth of the web should be the same as that of the vessel's chain stopper.

f. Take care not to drag over cable or restricted areas. If a cable comes up fouled in the grapnel, there will usually be a tremendous strain, and the cable must be securely stopped off, before attempting to clear it. Strong wire straps in pelican hooks can be used for stoppers. You may snag a "hogged shot" of chain between two or more sanded-in sinkers, and be unable to disengage the grapnel. Therefore chain used on the grapnel should be stronger than the chain of the mooring being searched for. This way, if all else fails, you can at least retrieve the grapnel.

g. As in working buoys, the current must be utilized to best advantage and should not be fought. Stemming the current and crabbing 10 to 15 degrees to each side across the current, while moving upstream at the end of each pass should provide a satisfactory search. Also, assuming that the buoy being searched for was struck by a ship or tug and tow, the most likely time would be when maneuvering is most difficult, i.e., during a strong ebb or flood. This usually results in a buoy settling somewhat along a line drawn through the mooring parallel to the local current. Dragging across this line produces the strongest possibility of successfully catching the sunken buoy's mooring chain. In areas where buoys are sunk by ice this analysis may be helpful. However, ice may not only be influenced by current but may move across the current when lying in large fields and being driven by the wind.

h. Do not immediately try to raise a large sunken buoy completely out of the water.

As an example, a 9 x 32 buoy, including batteries, weighs approximately 10 tons and may be supporting another 3 tons of riser chain if it is in deep water. If this buoy were to sink and be completely flooded, it would now weigh approximately 27 tons out of the water. This is considerably more than the safe working load of tenders (See **Table 8-1**.) The following points should also be considered:

(1) If a nonstandard buoy with open pockets is holed in the bottom, natural venting action of the buoy may slowly allow the water to run out of the hole.

(2) Raising the buoy part way out of the water and making a hole in the body below the internal waterline will also allow the water to run out slowly. Cutting a buoy body with water inside using a standard oxyacetylene cutting torch should only be undertaken by a qualified cutting torch operator.

(3) At best, the recovery of a large buoy by dragging is extremely time consuming and must be weighed against the time and cost involved. Consideration should also be given to other methods such as portable, side scan or forward scan sonar or the use of scuba divers.

2. Side Scan Sonar. Using side scan sonar to search for sunken buoys can save time and wear and tear on equipment. The success with this method depends on the type of bottom and the experience level of the sonar operator. Utilize the same techniques for developing a search pattern as with the grapnel. The track spacing can be increased based upon local knowledge of the bottom and the confidence in the sonar.

3. Buoys Washed Ashore. To salvage a large buoy washed ashore, the tender may have to send a party ashore to disconnect the mooring before attempting to pull it off the beach. There is a possibility of parting even a 6-inch nylon hawser when dragging a buoy attached to a mooring sunk deep in mud or sand. If the buoy is in the surf with mooring attached, at low water it could be rolled clear of the water. To do this run a hawser through a snatch block attached to a sand anchor or a "dead-man" ashore. By pulling in this fashion the working party may have a chance to disconnect the mooring. The buoy can then be pulled into the water. The hawser is always attached to one of the hoisting pads on the buoy except when the buoy is towed through shallow water by a small boat. Towing the buoy from the top of the cage will tip and reduce the chance of the tube snagging the bottom.

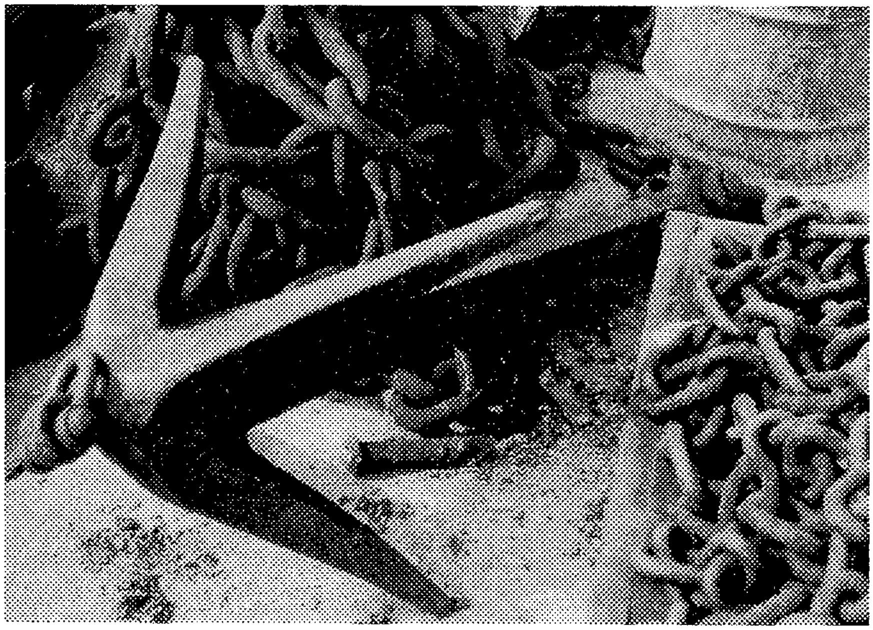


Fig. 8-10 Grapnel (Anchorhawk)

Characteristics / Buoy Type	Buoy Weight (LB)	Flooded Weight (LB)	Focal Height of Light (FT-IN)	Buoy Draft (FT-IN)	Freeboard (FT-IN)	Minimum Freeboard (IN)	LB Per Inch of Immersion
Lighted							
9X35 LHR	18,500	52,000	20-7	15-10	3-0	16	300
9X32 LR	17,500	53,000	21-2	11-7	4-7	16	340
9X20 B/GR	7,800	24,000	------	5-4	2-6	9	340
8X26 LR	12,000	34,000	15-9	10-4	3-1	15	264
8X26 LWR	12,100	33,000	15-8	10-4	3-1	15	250
8X21 LR	13,900	33,000	13-3	7-9	2-3	12	264
7X20 LI	6,500	19,000	9-10	10-7	3-5	3	170+
7X17 LR	7,700	24,500	11-8	5-6	3-0	12	205
6X20 LR	6,500	17,000	10-8	9-0	2-1	12	150
5X11 LR	3,000	9,000	7-11	3-9	2-1	9	105
5X9 LFR	1,500	------	6-7	2-9	1-1	6	105
3.5X8 LR	1,500	4,000	5-6	2-9	1-4	6	50
Unlighted							
1 CR	6,100	18,500	N/A	8-5	5-5	2-5	104
1 NR	6,000	18,400		8-2	5-8	2-5	104
2 CR	2,700	8,400		6-3	3-9	1-0	67
2 NR	2,600	8,300		6-1	3-11	1-0	67
3 CR	1,150	3,200		4-4	2-4	0-9	38
3 NR	1,150	3,200		4-4	2-4	0-9	38
5 CR	700	1,800		5-1	2-3	0-6	16
5 NR	700	1,800		5-1	2-3	0-6	16
3 CI	1,150	4,200		7-7	5-5	3-6	22
3 NI	1,150	4,200		7-7	6-5	4-6	22
5 CI	750	1,900		5-0	3-2	2-4	16
5 NI	750	1,900		5-0	4-2	3-4	16
4 CR	465	------		5-0	2-11	1-0	21
4 NR	470	------		5-0	2-11	1-0	21
6 CR	160	------		3-10	2-5	0-6	9
6 NR	165	------		3-10	2-5	0-6	9
6 CT	165	------		4-10	2-9	1-6	9
6 NT	170	------		4-0	4-2	2-6	9

Table 8-1 Sunken Buoy Weights.

CHAPTER 9: AIDS TO NAVIGATION WORK, INLAND WATERS AND RIVERS

A. General.

Rules of seamanship previously described for large tenders also apply to smaller tenders working in inland waters. Although the buoys, sinkers and chain are smaller and lighter, the fundamentals are the same. In addition to their floating aids, some units are also required to service minor lights ashore. Inland tenders are also required to do some construction such as building minor structures, and removing damaged or broken piling which are a hazard to navigation. Although most of the work of inland tenders is done in protected waters, they sometimes work in inlets or large inland bays where rough conditions can occur.

B. WLI Buoy Handling Procedures.

1. Overview. All of these vessels **(See Figure 9-1)** have a forward mounted boom and work buoys over the side. The capabilities of the tender may vary, but procedures are generally the same. There are several of the older WLICs that push a barge but can also perform the WLI mission independent of the barge.

2. Relieving a Buoy.

   a. When working buoys in less than ideal conditions, handle buoys with the same caution as described in this manual for working large buoys at sea. Secure your buoy deck before leaving sheltered waters. Take all possible precautions against swinging weights when the tender is rolling.

   b. When working small buoys in sheltered waters, the tender approaches to bring the buoy close aboard at the buoy port. The buoy is pulled close aboard with a boat hook, and the hoisting tackle is hooked into the lifting bale. Some tenders use a 4-inch line passed around the buoy to hold it close aboard until hoisted. The buoy is hoisted until the mooring chain can be placed in the chain stopper. As soon as the chain is in the stopper the buoy is lowered to the deck and unshackled. Now a second bight of chain may be taken by the hoisting tackle. Moorings are generally short since most buoys handled by inland tenders are in shallow water. If the sinker is to be used again, it is hung over the side in the chain stopper. The mooring chain is inspected for wear, replaced if necessary, faked out on deck and stopped off.

   c. Headlines or cage lines are used for all lighted buoys. In setting lighted buoys use similar procedures to those for setting the larger lighted buoys. The buoy is hoisted over the side and let go, usually at the same time as the sinker. Small unlighted buoys are often rolled over the side.

   d. When installing batteries in a 3-1/2 or 5-foot standard buoy, bring the buoy on board and place it upright. The entire cage assembly is then unbolted and removed from the top of the buoy. The battery rack can now be lifted out and replaced using the whip.

   e. Preparing buoys for setting in inland waters requires the same preparation, charging, inspection, tests, etc., as it does for the larger buoys.

f. Before allowing crew members to climb buoys on deck, ensure that the buoy has been secured with a head block to prevent the buoy from tipping. Crew members climbing a buoy must wear life jackets, eye protection, and hard hats.

g. On vessels having air-driven hoist, if you use the whip for steadying the buoy use the throttle, don't use the brake. Only crack the throttle to maintain a slight strain for steadying purposes, but not enough to bend the superstructure. Take care that solar panels or other equipment are not damaged when hoisting a lighted buoy.

h. When the buoys are located in shallow water, such as narrow channels, and if it is likely that the mooring will sand-in, make sure the mooring is long enough so at high water the buoy can be hoisted sufficiently to recover the mooring.

i. When buoys are to be set in shallow water and only a short length of chain is needed, the chain faked out on deck need not be stopped off except at the ends. **CAUTION:** All hands must keep clear of the mooring (chain or wire) no matter how small or how short. Never allow crew members to pass outboard of any chain faked out on deck.

3. Recharging a Small Lighted Buoy. The following is one procedure for recharging a small lighted buoy used by some Eighth District tenders:

a. The tender approaches the buoy against the current or wind, depending on which force is dominant.

b. The boom is spotted over the center of the buoy port, and slightly inboard of the edge of the deck, with a double-branch sling hanging on the relief purchase.

c. After the tender is alongside the buoy, steadying lines are passed around the fore and aft legs of the buoy tower. When this has been done, the sling is hooked into the lifting bales, and the buoy is raised until the battery pocket is level with the deck. The pocket cover is removed, the wires disconnected, and the battery hoisted out with the whip.

d. A new battery is inserted and connected, and the complete wiring system is megged and checked for correct voltage before replacing the cover. The flasher and lamp-changer are checked for proper operation.

e. The whip is hooked into another lifting eye, the slings removed, and the stoppers cast loose. The buoy is then lowered into the water.

C. Aids to Navigation Work Ashore on WLRs.

1. General. The Eighth Coast Guard District's Aids to Navigation Manual (CCGD8INST M16500.3 series), contains administrative and policy guidance for placement of aids to navigation in the Eighth Coast Guard District. That manual should be consulted for specific guidance on those issues. This section deals with the general seamanship practices of the WLRs (**See Figure 9-2**) on the rivers of the Eighth District.

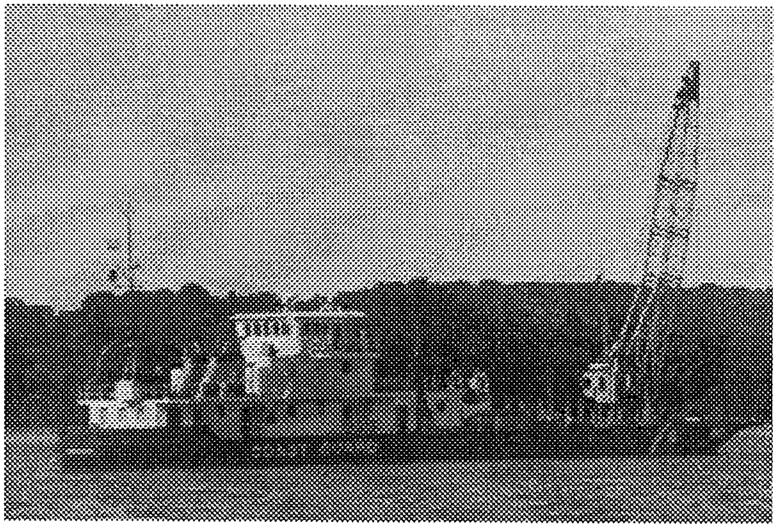


Figure 9-1 WLIC

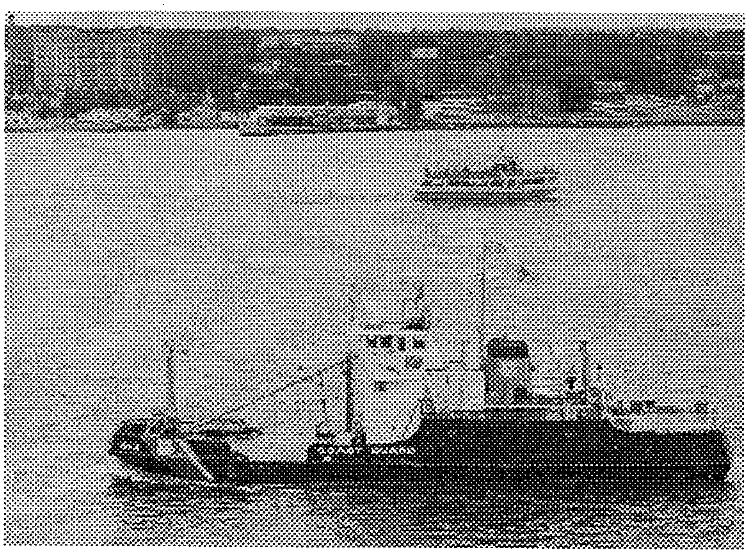


Figure 9-2 WLI

a. Servicing aids on rivers presents different problems at different locations. For instance, brush and tree cutting on the lower Mississippi is a major item in servicing aids ashore. On the upper Mississippi the problem is not as great. Most structures don't require painting since pilings are pressure treated and towers are galvanized. For those few structures that still require it, painting may be deferred on rivers likely to suffer from a major flood in the near future.

b. One problem with shore aids on some of the rivers is their survivability during floods. The structures have to be frequently moved either because of channel changes or eroding banks caused by changing water levels. Many structures are lost in this manner. During high water when the banks are overflowed, the lights and associated electrical gear are removed until the river recedes sufficiently to replace them.

c. In addition to routine servicing of the light, shore aids should be checked for condition of the daymarks and to ensure that they are stable and level.

d. Because of the rise and fall of the rivers, some units place a daymark on exposed lock walls and also shackle a buoy next to the daymark. The daymark has its stand secured in a concrete sinker which is also shackled to the lock wall. When the water rises and the daymark is no longer effective, the buoy serves as the marker for the lock wall. When the water falls, the unit can again visit the aid, which has been moved but it is hoped, not lost to the flood. Reposition the buoy so when high water returns, it will again mark the lock wall.

2. <u>Building Shore Structures</u>.

a. Constructing shore structures along rivers is a job requiring ingenuity and common sense. Much of the trouble of building structures has been solved by the use of "TV Towers" (3-legged, cross braced, metal structures) (**See Figure 9-3**.) Metal towers are erected in sections with a base plate and guy wires. These guy wires are used on installations beyond the tender's reach. Do not attempt to climb a "TV" tower structure until you have double checked all guy wires and made sure that the structure is properly guyed. The sand anchors should be firmly anchored in the ground. Anchors have been known to pull out of soft ground or after heavy rains. Become familiar with the requirements for guying aids depending on tower height.

b. Usually, river shore structures are elevated as high as possible to prevent their being carried away during flood stage. To construct and maintain them requires either an extension ladder or linesman's spikes. Prior to climbing a structure, conduct a thorough visual inspection of the structure. Do not attempt to climb a structure or steps that appear rotten or weak. If using an extension ladder, be sure that it has enough support angle when leaned against the structure to safely support the climber. Once the servicing technician is on the tower all hands should stand clear of the tower. Wear a hard hat and eye protection when working on or around a structure. Tools should be equipped with a lanyard to prevent them from falling.

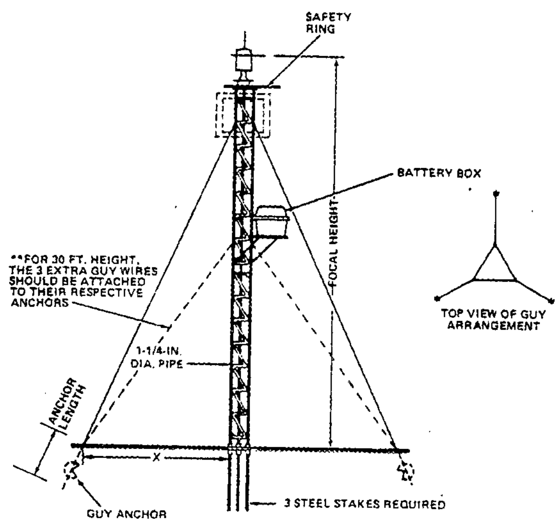


Figure 4-21. Single guyed skeleton tower.

Data Sheet 4-D(9). (cont'd).

Fig. 9-3 Aton structure (D2 TV Tower)

c. When clearing brush, you must be constantly aware of the location of all persons in the work party. Do not work too close to other people. When felling trees, take care in choosing a landing site and escape route before commencing. Make sure a large enough clearing exists before a tree is permitted to fall. Always be sure of your footing and make sure that brush, vines, etc., are clear from overhead before swinging an axe or brush hook. All persons who use chain saws, brush cutters, etc., must have received adequate training and wear proper protective equipment (safety glasses, hard hats, chaps, etc.).

d. All tower structural parts and materials should be precut or preassembled as much as possible, painted, and be ready to be erected on the spot. Units should carry extra towers, sand anchors, guy wires, and lumber to repair or replace towers or structures as needed.

e. Most lighted shore aids use 155mm lanterns and 10-watt solar panels.

3. Servicing Shore Structures.

a. The servicing of lights on river structures is similar to the procedures described for other structures elsewhere in this manual. However, some unique problems exist. Lights along railroad tracks will need shields to keep the lights from shining toward the tracks. High bluffs and vegetation often interfere with solar panels and will require larger than normal panels or creative placement to get adequate exposure. Steep hills may require the use of block and tackle rigs to get gear up to the structures.

b. Wasp's nests are often found on shore structures and in battery boxes with the screens missing. A good spraying of the battery box with commercial insecticide, which can be applied from a distance, will often remove the wasp or hornet problem. Another deterrent to insects is to place moth balls inside the battery box. In any event be careful when working on structures. A sudden wasp sting could cause you to lose your balance and fall.

c. Some insecticides are made with volatile petroleum hydrocarbons, such as gasoline, kerosene or naphtha. These solvents may be harmful to plastics.

d. Snakes can also pose a problem at certain times of year. Personnel should be careful that they do not place their hands or step where they cannot see. Sunny rocks and platforms are a favorite early morning and evening haunt of snakes when the temperatures begin to drop. A little caution and respect will prevent accidents.

e. Poison ivy, poison oak and poison sumac will move rapidly into the fringe of clearings around structures. Personnel should be familiar with local plants' appearance and wear clothing that will prevent direct exposure. Use EPA approved herbicides.

D. Aids to Navigation Work Afloat on Rivers.

1. General.

a. A satisfactory ATON system on a river calls for local knowledge of the river plus a knowledge of the types of vessels and their methods of navigation. On pooled waters, the gauge above and below a section to be buoyed must be known, (i.e., the present reading, the low water reading, and the project depth for the section). For example, to place a buoy at mile 223.0 Upper Mississippi River, the Dixon Landing gauge at mile 228.3 Upper Mississippi River and the Grafton gauge at mile 218.0 Upper Mississippi River must be known. The project depth for this section of river is 9 feet. The present gauge reading is 7.58 feet. Grafton's gauge current reading is 15.0 feet, low water 14.2 feet. With this information the slope is computed on graph paper. Reading from the graph thus constructed, at mile 223.0 it is found that the buoy in question must be placed in 9.6 feet of water to maintain project depth. On open rivers, keep apprised of the river stages, forecasts, and weather forecasts to anticipate changing river stages.

b. The channel width will be maintained at the maximum width consistent with Corps of Engineers' project depth. However, in periods of low water, it is not always possible to maintain the published project depth or width. As a result the channel must be narrowed. If project depth or width cannot be maintained at the Corps of Engineers' published minimum, a Broadcast Notice to Mariners must be issued.

c. Perhaps more than in any other type of aids to navigation work, intimate piloting knowledge of the local area must be thoroughly learned. Experience and local knowledge play a vital part in a well maintained channel.

2. Working Buoys. River tenders work buoys from a barge pushed ahead of the vessel. Unlighted buoys are stowed in a pen amidships on the barge (**See Figure 9-4**.) Wire rope for moorings is placed forward, sinkers along the side, chain for moorings aft, and lighting apparatus inside the barge workshop. WLRs work buoys in two different ways. Which way is determined by where the cutter is located and which river environment they work in.

a. On the pooled rivers, generally the Ohio, Tennessee, Arkansas, and Upper Mississippi (above St. Louis) River levels are controlled by the Army Corps of Engineers. The water levels are relatively stable and buoys seldom move. The buoys are set using sinkers with wire rope or chain moorings.

b. On the Mississippi River below St. Louis and the Missouri River, which have a wide range of water levels and a constantly changing bottom, the position of both buoys and dayboards are always changing. Crossing boards are used to mark the channel as it moves from one bank to the other and buoys are set using sinkers with wire rope. On the Missouri River in areas with a soft bottom, buoys are set using a "jet pipe." A jet pipe is a device which uses water pressure to force a cone connected to a wire rope mooring into the bottom to hold the buoy on station. In areas with a rock bottom the buoys are set using sinkers.

3. Buoys and Equipment.

a. ATON hardware used in the Eighth District (rivers) is a little different, for economy or function, from the equipment used elsewhere in the service.

b. Buoys (i.e., 4th class) are metal, foam filled, radar reflecting, with a fin to stabilize them in a swift current. A few lighted buoys are set in pooled areas.

c. Sinker weights vary, with 1000 and 1500 pounds being the most common. There are two bails on the sinkers. One bail is on the top of the sinker and is used as a lifting eye. The second bail is on the side of the sinker, and is used for the attachment of the wire rope or chain. The side mounted attachment offers the least amount of sinker profile during retrieval. The wire rope used to secure the buoy is also used to retrieve the sinker.

d. Most 6th class river buoys (**See Figure 9-5**) are attached to 1000 pound sinkers or jet cones using 1/2" or 3/8 inch wire rope and wire rope clips. When sinkers are used, the wire rope is coiled on top of the sinker or set over the side by dropping the coil before setting the buoy to prevent fouling during the buoy deployment.

e. Use of 4th class buoys (**See Figure 9-6**) is common where 6th class buoys do not have enough buoyancy to provide a good visual aid for the mariner. Usually 4th class buoys are deployed with 1/2" chain or 1/2" wire rope moorings and a 1500-pound sinker.

4. Deck Equipment. Deck equipment on the WLRs is relatively simple but effective.

a. A bolt cutter is always kept available to cut wire rope. This is the fastest way to clear a fouled buoy or sinker.

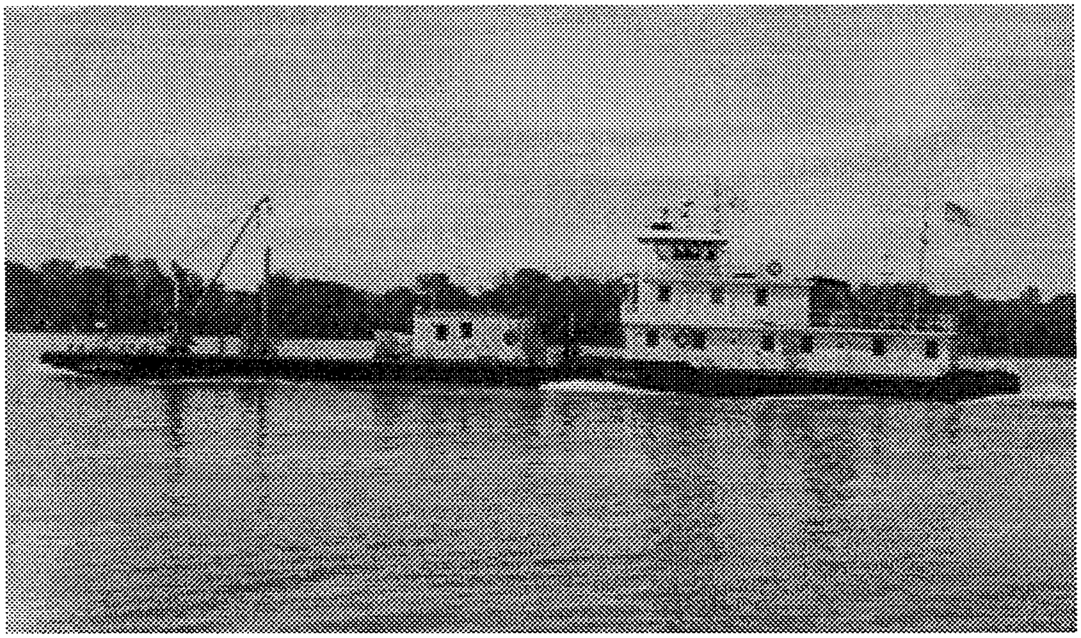
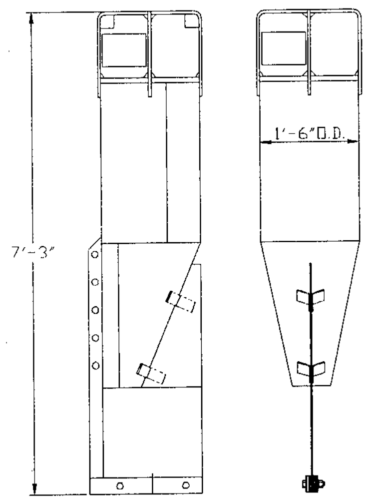
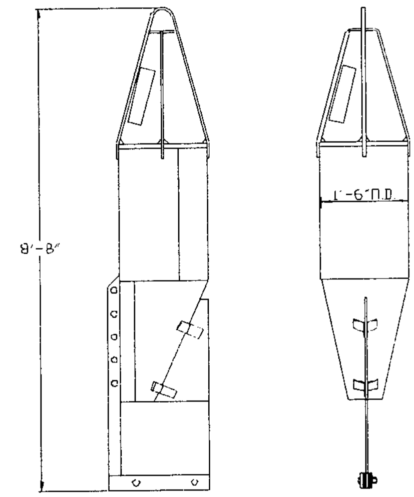


Fig. 9-4 WLR with 130′ Barge

Figure 9-5 Types of 6th Class Fast Water Buoys

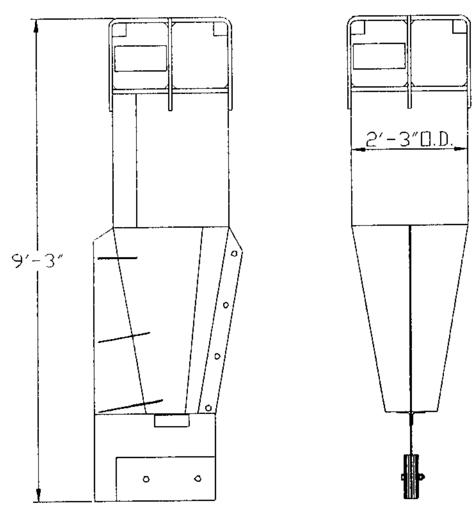


6CR River Buoy

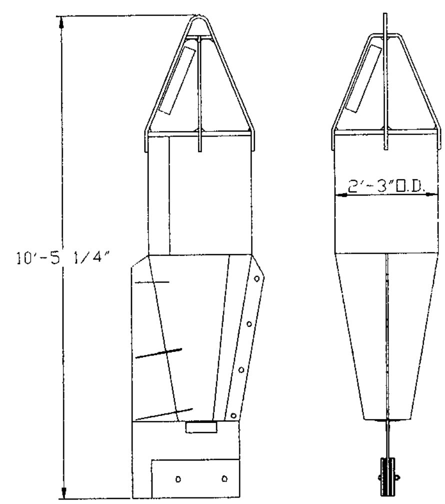


6NR River Buoy

Figure 9-6 Types of 4th Class Fast Water Buoys



4CR River Buoy



4NR River Buoy

b. A 1/2" wire rope lasso is used to "lasso" the buoy. The wire is then taken to the capstan and the buoy is dragged aboard the tender.

c. A cable stopper, attached to a length of wire or chain to the base of the capstan, can be used to secure wire rope much in the same manner as a chain stopper. The wire rope stopper or "Chicago gripe" has a friction catch and will stay closed as long as a load is on the device. A length of wire with a hook attached can be hooked into the buoy mooring eye and taken to the capstan before freeing the mooring.

d. Sinkers are normally set in one of two ways. Either two crowbars are placed under the sinker and used to slide it overboard, or the sinker is placed on a dump board. The dump board allows a single person to deploy a sinker because of the mechanical advantage of the lever.

e. WLRs have chain stoppers to handle the chain moorings.

f. Cranes on WLRs are all 360-degree rotating pedestal types made by various manufacturers. The 130' barges and others have an articulating crane with a boom and jib controlled by hydraulic rams. These cranes are manufactured by Appleton and Allied. None of these cranes are designed for sideloading and all lifts should be as straight up and down as possible.

5. <u>Buoy Relief Procedures Wire Rope Mooring</u>.

a. On pooled rivers the spuds are not normally used to work buoys. They are used as a mooring device when the cutter is pushed into the bank. On pooled rivers and in deep water the tender will stem the current and work the aid. When using the jet pipe tenders will spud down to provide a stable platform. Any movement of the ship could bend, or break, the jet pipe.

b. To relieve a buoy, the conning officer maneuvers the vessel bringing the buoy close enough to be lassoed. After the buoy has been lassoed, the end of the lasso wire is taken to the capstan and the buoy is winched aboard. A preventer chain, with a hook attached to a dead eye at the base of the capstan, is hooked to the buoy for positive control.

c. If only the mooring is to be checked the wire is pulled aboard by hand until enough wire is aboard to do a thorough inspection. If the buoy and wire are in good condition and the buoy is on its AP, the buoy is pushed back into the water after the snap hook is released.

d. If the buoy is no longer serviceable or the wire rope is worn, the buoy has to be relieved.

e. To check the buoy, lift it by the lifting bale to check the weight. A leaking buoy will be heavier and must be removed from service if it cannot be drained and patched. Buoys without holes can be painted and "retroed" and returned to service. Buoys with small holes above the waterline, which do not contain any water, may be patched with body putty and returned to service. Buoys which have been holed or have cracked seams and contain water or mud should have a large drain hole cut with a fire axe and should be marked with spray paint to indicate they are scrap. These buoys must then be disposed of by following Eighth District Instructions.

f. If the wire rope shows signs of abrasion, crimping or if it contains kinks, it must be replaced to prevent the buoy from breaking loose.

6. Buoy Relief Procedures for Chain Moorings. The relief of buoys with a chain mooring is almost the same as those with wire mooring. The snap hook and line are used only to get the buoy abeam the chain stopper where it is hooked with the main purchase.

   a. Once the buoy is hooked, it is lifted just high enough to clear the chain stopper so the chain falls into the chain stopper and is then secured.

   b. The buoy is then disconnected and dragged out of the way. Buoys should never be raised above the heads of crew members and left suspended while they pull the chain into the chain stopper with chain hooks.

   c. Once the buoy has been disconnected the chain is pulled using the main purchase. A chain grab hook is preferable to a nipper chain for this operation because it is less likely to slip than a nipper chain.

   d. After the next pick has been taken, the chain is pulled into the chain stopper with either chain hooks or a line with a grab hook attached to the end. The line with the grab hook is preferred because it reduces the time to hook and gets personnel away from the chain should it part.

   e. This process is continued until the sinker is aboard.

7. Buoy Setting Procedures.

   a. When setting buoys using a jet pipe, the position of the buoy is determined and the spud is dropped. The jet cone is attached to the wire rope and then over the end of the jet pipe and put to the bottom. The jet pump is then engaged and the water pressure forces the jet cone into the soft bottom and buries it. The wire rope mooring is then cleared from any obstructions on deck and the buoy is pushed overboard.

   b. If the buoy uses a sinker for mooring, the wire rope is coiled on top of the sinker and attached to the buoy. When in position, the sinker is tripped and the wire rope is thrown overboard clear of the sinker to prevent fouling. Then the buoy is pushed overboard.

   c. After the relieved buoy is disconnected and boomed out of the way, a fresh buoy is moved to the buoy port and connected to the mooring chain. The buoy deck supervisor will then direct that the chain stopper be tripped and the drag chain pulled over the side.

   d. Personnel should keep hands and feet well clear of moorings when setting buoys.

8. Positioning. Placement of buoys on Western Rivers is done to mark a channel of a specific minimum depth and with the maximum width possible.

a. The WLR Officer-in-Charge has wide discretion in positioning aids to navigation. This authority is spelled out in CCGD8INST M16500.3 (series), Eighth District Aids to Navigation Manual.

b. The positions of buoys on pooled rivers remains fairly constant. Shoaling does occur but rarely does the channel shift dramatically, as it does on the uncontrolled rivers. Because of infrequent shifting buoy positions are more easily determined using landmarks on shore with bottom soundings. In other areas WLRs must rely on water depth to determine the course and width of the channel to be marked. They must also adjust crossing marks so mariners will know that the channel has moved.

9. Dragging Buoys. Sometimes you must drag a buoy a short distance. This is normally done by maneuvering the bow of the barge alongside the buoy on the side corresponding to the direction in which the buoy is to be dragged. The buoy is steadied with a boat hook and the drag chain is pulled through the bail, then back to the chain stopper. The tender then eases back, pulling the sinker loose from the bottom. Once the sinker is loose, the tender moves ahead, dragging the buoy and mooring to the new position. Once in position, the conn will pass, and "set the buoy." The chain stopper is then tripped, freeing the drag chain from the stopper. Always have a standby buoy and mooring ready in case the wire should part. Using shore range(s) will help quickly determine the new position. Always check your position with a sounding.

CHAPTER 10: AIDS TO NAVIGATION, CONSTRUCTION TENDERS

A. General.

1. Mission. The primary mission of an aids to navigation construction tender (WLIC) is to build aids to navigation structures, including the removal of ATON wreckage. In addition, they are often called upon to do major marine construction (i.e., piers, docks, seawalls, etc.). While most of their work is done in protected waters they often work near inlets and in open bays and sounds. Some construction tenders are assigned buoys to service, including some of the smaller lighted buoys. While a construction tender is a ship in all aspects it does have certain unique characteristics. It can "spud down" to maintain a precise position and has a large crane or A-frame for driving piles. Good seamanship practices are as important on a construction tender as they are on other vessels. In fact, duty on a construction tender is considered some of the most hazardous of that on all the tenders.

2. Classes of Construction Tenders. Presently, there are three classes of ATON construction tenders: the 75' ANVIL class with a 68' construction barge, the 100' RAMBLER class pushing a 68' construction barge (PRIMROSE is the only 100' WLIC that has a A-frame and does not push a barge) and the 160' PAMLICO class which has an installed crane. While each class is unique, each is capable of building fixed structures, recovering wreckage, and major marine construction.

B. Construction Operations.

1. General. Most construction consists of rebuilding destroyed aids to navigation. While some structures are destroyed or damaged by natural causes (i.e., storms) most are destroyed by collision from passing vessels. The tender is usually notified of the damaged or destroyed aid by message. Unless it is a critical aid, the tender schedules to repair or rebuild it when next in the area. The pertinent information required to rebuild (i.e., type of structure, lantern, lamps, etc.) can be found in ATONIS and the Aids to Navigation Assignment List. If it is a new aid to be established the district (oan) will provide the required information on an ATON Work Order. Each tender should have on board a complete set of drawings for the various types of ATON structures (i.e., single pile, dolphin, range, etc.).

2. Position. When a construction tender arrives on scene to rebuild an aid, usually the location has been marked with either a TRUB or TRLB. The area should have been wire swept and the wreckage removed, if possible, by the responsible Aids to Navigation Team (ANT) or other unit having primary responsibility. If the area hasn't been wire swept it must be done to insure that no portion of the old pile(s) or structure remains above the mud line, creating a hazard to navigation. This cannot be overemphasized, THE AREA MUST BE WIRE SWEPT to insure that no portion of the old Coast Guard structure remains. The Coast Guard has had to pay hundreds of thousands of dollars in lawsuits when wire sweeping was not done or was done improperly. A brief discussion of wire sweeping techniques can be found in the

chapter dealing with Aids to Navigation Teams in this manual. After the wreckage is removed, the position for the aid is located utilizing sextant angles, Differential GPS, LORAN, soundings, or other approved methods. Never assume that the TRUB/TRLB set by the ANT is the correct position, until it is verified. Winds, currents, or a passing vessel could have moved the temporary buoy from station. Additional information on positioning can be found in CG ATON Positioning Manual; COMDTINST M16500.1 (series).

3. Depth of Water. Carefully sound the depth of water at the site and determine mean low water, making corrections for height of tide at that moment.

4. Preparation of Piles.

   a. Having previously determined the actual and projected depth of water at the assigned position (AP), you can determine the length of pile needed. Three pieces of information are needed to determine the actual length of pile(s) required: (1) depth of water, (2) type of structure, and (3) the fixity required. If a wood pile needs to be cut, ensure that you cut it squarely with the axis of the pile, so the pile will receive the full force of the hammer blows. Some units sharpen the tips (small end) of the pile to facilitate driving. A very sharp tip should be avoided to prevent the possibility of brooming the point. Metal points are often nailed on the tips to allow the pile to be driven in hard bottom. Steel piles are driven in nearly the same manner as wooden piles.

   b. In cases where the pile cannot be driven to its required penetration because of an exceptionally hard bottom, if the penetration obtained is reasonable, the pile is left in place and the top is cut off at the correct height. The correct height can be determined by the present depth, pile height at high water and the focal height required.

5. Pile Driving Equipment. All but one vessel has a CG-300 pedestal mounted crane and Delmag D6 diesel-fired hammer (See **Figure 10-1**.) On barges with the CG-300 cranes, leads can be tilted to permit the driving of batter (angled) piles. The CG-300 crane has three leads; one for holding the pile, one for holding the lead and one for starting the hammer.

6. Jetting.

   a. Jetting is the use of water pressure supplied through a pipe along the side of the pile to facilitate pile driving (See **Figure 10-2**.) The purpose of jetting is to loosen the soil under the point by water pressure. It is most useful in sinking piles when pile driving equipment is lacking. It may be used alone or with compressed air or a weighted pile. A weighted pile is one with a sinker, or other heavy object, resting on top of the pile.

   b. Jetting is useful in assisting the driving of piles with standard pile-driving equipment in hard bottom conditions and is especially effective in sand and gravel bottoms. The jet water should be delivered to the pile point in sufficient volume and pressure to wash away the soil from under the point and to reduce the friction of the soil around the pile body. After the pile has reached its desired penetration

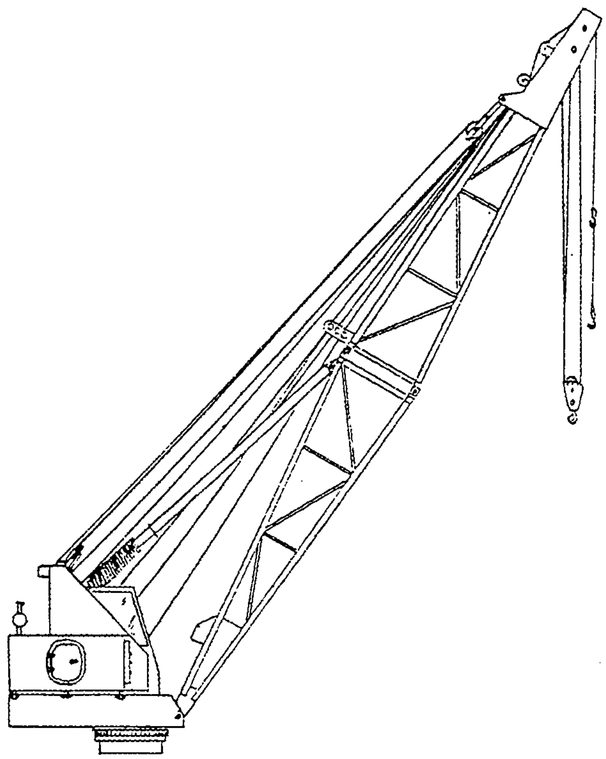


Fig. 10-1 CG-300 Crane & D6 Diesel Hammer

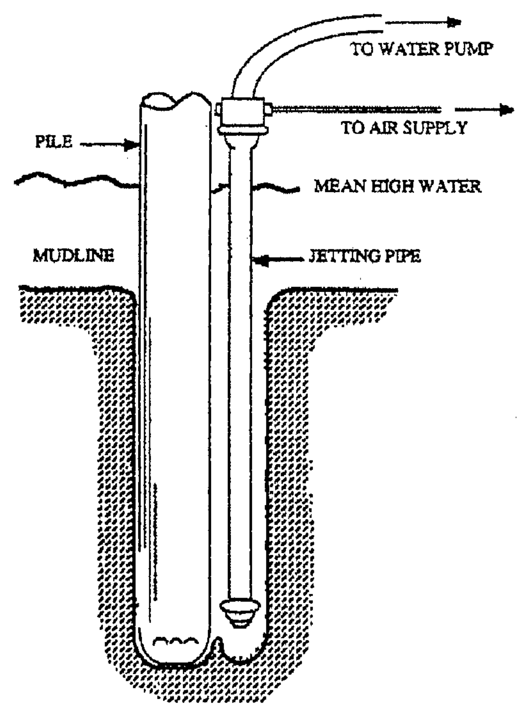


Fig. 10-2 Jetting with a single jet pipe

and the jetting stopped, the soil settles naturally around the pile to retain it in position. When jetting is used with pile driving equipment, jetting is usually discontinued a few feet before final penetration is reached. The pile is driven the remainder of the distance with the hammer alone. Fire pumps delivering 150 gpm make excellent jet pumps.

c. The jet pipe is sometimes secured to the wood pile by means of staples and straps, nailed in such a manner that the pipe can be pulled free. Usually, it is best to keep the pipe in constant motion up and down and around the pile. It is easier to suspend the pipe from an overhead rig permitting free movement of the pipe.

7. Pile Driving Hints.

a. If the pile head begins to broom excessively it indicates that the pile has been driven to refusal. If the penetration must be continued, the pile must be assisted by jetting.

b. If the pile begins to stagger and the hammer bounces, it's an indication that a boulder has been encountered, or that the pile has split somewhere in the ground. In such cases the pile should be pulled and a new one driven in an alternate location..

c. To aid in the construction of a three-pile structure, a jig for properly placing the piles in a triangular position may be built. To construct such a jig, place three 12-foot pieces of 2 x 4 lumber in a triangle with the ends overlapping. Place a deck bucket, about the same diameter of the pile, in the vee formed by these overlapping ends, and adjust the pieces of lumber to give equal sides according to the distance specified between the pilings. Nail the (2 x 4s) together and cut off the ends. After the first pile has been driven, use the jig for positioning the remaining piles. Remember the piling must be driven so when the daymarks are secured to the finished structure they will be clearly visible both up and downstream.

d. After the pile has been jetted, allow time to permit the soil to settle around the pile to stabilize it. Twenty minutes or so is usually sufficient.

8. Sawing Pile Tops. After the pile(s) have been driven, or drawn into position, the top(s) are sawed off at the required level. To saw the pile squarely, use wood cleats to guide the saw. The cleats are placed on opposite sides of the pile. It is preferable to use the top and bottom cleats with enough space between to permit clearance for the saw blades. Before cutting, a strap must be placed on the portion of the pile to be cut to prevent its falling either into the water or on deck. Place the strap above the point of balance, as near the top as possible, attaching a tag line to the pile and tending it from deck. The crane operator must be extra alert when the pile is cut to prevent excess swinging of the "nub" after cutting.

9. Completion of the Structure. Since there are several different types of structures, the construction of platforms, daymarks, lantern stand, etc., will require the unit to follow those specifications of chapters 4 and 5 of the ATON Technical Manual; COMDTINST M16500.3 (series).

10. Wreckage Removal.

a. Tenders are often called upon to remove old piles from destroyed or discontinued aids. These piles are sometimes pulled without much effort, using a heavy chain ("nipper chain") or heavy wire strap passed around the pile and hooked to the main. Steel piles are harder to pull than wood, and other methods must be used to get them out. A few downward blows on the pile by the hammer may loosen the pile sufficiently to facilitate pulling. When pulling piles with the main, be sure your whip, or another preventer, is hooked into a deck padeye to prevent shock loading your boom if the strap or pile should break.

b. If piles are located in sand and refuse to come out, jetting may help. Set taut on the pile with the main hoisting tackle and hold fast. Rig your jet pipe and hang it from the whip alongside the pile to jet the sand away. Use all pressure available and keep the jet pipe in motion (i.e., lower it, raise it slightly, and lower again); if you don't keep the pipe in motion it may "stick" and can be difficult to retrieve.

c. When pulling piles from hard clay and mud bottoms, jetting may not work. In this case, set taut on the pile with the main and pass a length of 3/4 inch, or larger, chain around the pile at deck level. Secure this chain on deck to steady the pile fore and aft. Work the ship slowly ahead and astern to loosen the pile. Stubborn piles require patience and perseverance but nearly all of them can be pulled eventually. Piles should never be run over with the ship or barge. They can snap off above the mud line and will create a hazard to navigation. The practice of running down piles is not authorized.

11. Handling Piles. The use of tongs or hooks in loading piles is not authorized. Several accidents, one death, and many narrow escapes have resulted from their use. Pass a sling around the pile. This requires a little more time and the piles must be wedged to pass a round turn of the chain. In some cases, such as floating piles, this procedure may not be feasible, but whenever possible straps should be used. Personel handling piles should wear gloves. A splinter from a creosote or salt treated (CCA) pile can become a serious injury. Special care should be taken when dragging piles on deck, to keep side loading of the boom to a minimum.

C. Pressure Treated Piles, Timbers and Lumber.

1. Background. The Coast Guard has been using wooden piles to build fixed aids to navigation structures for many years. To make these piles more resistant to rot and destructive marine organisms, and thus last longer, piles that had been treated with creosote, a wood preservative distilled from tar, was used. Coast Guard construction tenders have "driven" thousands of these creosote-treated piles over the past 50 years. Commercial contractors building piers, wharfs, and bridges have added many more thousands of creosote piles to our waterways. Today hundreds of thousands of creosote piles can be found, especially in the mid-Atlantic, southern and gulf waterways. Creosote was found to work well, almost too well; creosote treated piles last almost indefinitely. However, this longevity is not without a price. Creosote slowly leaching from piles creates an environment that can be toxic to marine organisms. It has also been found to be carcinogenic in humans, causing skin cancer.

In recent years we have been utilizing piles treated with a solution of Chromated Copper Arsenate (CCA). Although CCA piles are "cleaner" to work with than creosote, they still pose certain risks to personnel and the environment. Safety precautions will be discussed later in this chapter.

2. Preservative Treatment of Piles with Creosote and CCA. The pile treatment process for both preservative solutions (creosote and CCA) are almost the same. A soft wood pile (normally southern yellow pine) meeting certain contract specifications (i.e., free of rot, no large splits, etc.) is immersed in a sealed vat of either creosote or CCA solution. Pressure of up to 3 pounds per square inch forces the solution into the wood. The preservative should penetrate almost to the center portion of the pile. This low pressure may not sound impressive, but too much pressure cracks the wood fibers and breaks open the cells making the pile brittle. Piles treated with creosote are more flexible than those treated with CCA. CCA piles are commonly called "salt treated piles" and the timbers and lumber as "salt treated lumber," because of the arsenic salts used in the preservative.

   Note: Specifications for marine wood piles can be found in the American Society of Testing Materials (ASTM D25-79) and the American Wood-Preservative Association (AWPA P5-81). The Civil Engineering Unit (CEU) will provide copies of these publications upon request.

3. Use of Wooden Piles and Timbers in ATON Construction.

   a. Piles: The majority of wooden piles used for fixed structures are 45' long with a head diameter of 12" - 14." Shorter or longer piles can be ordered as needed. Piles are ordered from a commercial contractor and delivered to the cutter where they are stored until needed. Today nearly all piles and timbers used are those that have been treated with a solution of CCA. In some areas that have a high structure knockdown rate (not expected to last for 12 months) piles may be left untreated.

   b. Timbers and Lumber: During the construction of multi-pile structures (i.e., dolphins, range structures, etc.) a variety of wooden timbers and lumber is used. These timbers and lumber may range in size from the smaller 2" X 4" boards to a 12" X 12" cap log or mud sill. Timbers and lumber are pressure treated with either creosote or CCA preservative in the same manner as piles.

      Note: See CHAPTER 4 of CG ATON TECHNICAL MANUAL (COMDTINST 16500.3 series) for additional information on marine construction.

4. Safety Precautions. Both creosote and CCA pose certain health risks to personnel and to the environment. A common sense approach is the best method of protection when working with these substances. The following information is provided as the minimum protection for personnel working with either creosote or CCA-impregnated woods.

   a. Creosote: A carcinogen that is rapidly absorbed through the skin. Two of the most common dangers from creosote are from infection and chemical burns. Infection often results from wood splinters, and the evaporation of creosote can cause chemical burns. You do not have to come in contact with creosote to receive a 2nd degree burn. Working near creosote on warm days is all that is required. The hotter the day, the quicker creosote evaporates, and the quicker you'll get burned without adequate protection.

(1) Protective clothing. Wearing gloves and long sleeve shirts is required when working around creosote. Personnel working with creosote should use coveralls or a neoprene apron, and barrier creams. Contaminated clothing should be removed and cleaned before being used again. If these simple precautions are taken, creosote isn't a threat. Goggles and an approved dust respirator are required when cutting piles or timbers.

(2) Treatment of exposure. To treat creosote in the eye(s), flush with water for at least 15 minutes. If creosote comes in contact with the skin, clean with alcohol and wash with soap and water. In all cases of severe contact with creosote see a physician as soon as possible. Burning is not an accepted disposal method and some states require creosoted wood to be treated as hazardous waste. Burning creosoted wood produces a hot flame with intense black smoke that is toxic. Symptoms of inhaling the toxic fumes are visual impairment and difficulty with thought and speech processes. Prolonged exposure may result in vomiting, excessive salivation, respiratory difficulties, weak pulse, dizziness, headache, loss of reflexes in the pupil of the eye, hypothermia, and mild convulsions. If creosote smoke is inhaled, remove the victim to fresh air, administer first aid, and have the victim seen by a physician. If creosote is swallowed, have the victim drink water or milk, but do not induce vomiting.

b. Chromated Copper Arsenate: Although CCA-treated piles and timbers have become the wood of choice for marine construction, there are still dangers. As the name implies the wood has been treated with chromate and arsenic salts, both of which are poisonous.

(1) Protective clothing. Gloves and long sleeve shirts should be worn when working with CCA piles and timbers. Goggles and a respirator should be used when cutting.

(2) Treatment of exposure. Arsenic poisoning can result from getting the poison (the greenish substance in the wood) on the skin, in the eyes, or from either inhaling or ingesting the dust from cutting. For skin contact wash with soap and water; if in the eye(s) flush with water for at least 15 minutes. If inhaled or ingested see a doctor as soon as possible. The fumes and ashes from burning CCA wood contains a concentration of chromate and arsenic. Do not burn CCA wood scraps.

CHAPTER 11: AIDS TO NAVIGATION WORK ASHORE IN COASTAL WATERS

A. Preparation.

1. Planning. Careful planning will eliminate needless trips by the work boat. The supervisor of the work party must know what is expected to be accomplished and that all essential equipment (including a first aid kit) is loaded. The use of portable radio(s) is essential to accomplish the work and for the safety of the crew. Maintain a check list for servicing parties to insure optimum performance during the visit to the aid. Carry small tools ashore in a canvas bag. Materials such as roofing, plywood, lumber, etc., are taken ashore and staged for use as needed. If possible, schedule the work when the wind is blowing offshore to reduce the sea and swells along the beach.

2. Tide. Know the stage of the tide when working any aid. Certain aids can be worked only at certain stages of the tide. In areas with a large tidal range, the handling of heavy gear (i.e., batteries) is easier at high water. Plan to begin the work before the tide starts ebbing; if the water is falling fast, the boat may have to stand clear.

B. Transitting to the Aid.

1. Inland Waterways. When operating small boats in inland waterways, slow down if you must leave the channel. Use slow speed when going close to bridge fenders, wharfs, piers, etc. Often tree limbs or other debris jam between the pilings under the surface. Even if you think it was clear the last time you were there, be cautious. Take advantage of the current when making long trips. Reduce speed in areas where a boat's wake can cause damage. Always obey posted speed limit signs. When passing under, or through, bridges or transiting locks, SLOW DOWN.

2. Approaching the Aid.

   a. It is better to approach a marine structure from the leeward. If possible, land on the side of the structure closest to the door of the battery house. Stem the current, if it's strong. Most offshore exposed structures are protected by stone riprap; avoid grounding your boat if at all possible. Under ideal conditions, it is better to drop an anchor offshore and approach cautiously, taking soundings as necessary. If an anchor is used, a tripping line should also be used.

   b. When servicing a light on a breakwater, an anchor may be dropped as the small boat approaches bow-on to the breakwater. Then, weather permitting, bow and stern lines are passed ashore and the anchor line is shifted to lead from amidship outboard to breast the boat off the breakwater. Use long leads on the bow and stern lines. If possible, leave a crew with the boat and stand off while the shore party completes the work.

C. Work Ashore.

1. Small Boat. Maintain a continuous watch from the small boat while the working party

is ashore. A boat can easily be grounded with a change of the current, wind or falling tide. Watch for bolts or sharp ends of timbers projecting from marine structures. When in an area with rapidly changing tides the small boat should be kept close until the personnel are safely above the high water line.

2. Slippery Conditions.

   a. When servicing aids ashore in winter, ice can be treacherous. Kelp-covered rocks also make slippery footing. Spreading sand on the ice may make the going safer and easier. When crossing a frozen body of water, use a small skiff. Push, or pull, the skiff (i.e., aluminum work punt) with the gear in it. Should the ice break, or if an open lead of water is encountered, the skiff will support the work party as well as provide a means of transportation. All personnel must be in survival suits (or dry suits) when on the ice. If a skiff is not used the gear should be packed on a toboggan and pulled. Personnel should each carry a boat hook, or other stout pole, for probing the ice and for breaking a fall should the ice fail.

   b. Many structures which are located in exposed areas have ladders on the side sheltered from the prevailing winds. On round, or nearly round, structures the ladder is at the point where the waves rounding each side of the structure meet. In winter considerable ice may form as the spray splashes on the structure and freezes. Personnel should use extreme care when climbing any ladder, checking for rotten, rusted, or missing steps as they proceed.

3. Hoisting Gear up to Lights. When aids to navigation are located in areas inaccessible to most boats, vehicles, and helicopters, the problem of landing personnel and equipment requires pure ingenuity. Personnel servicing shore aids in steep rocky areas must be alert and in good physical condition. Personal protective equipment (i.e., hard hats, etc.) must be worn. Around cliffs, it's common to erect an A-frame or sheer legs, sink a deadman in the ground, or secure a tackle or snatch block directly to a tree or to the structure. Equipment and materials can then be hoisted from the beach or boat. The small boat is often used as a source of power for hoisting. Gear is carried ashore in various types of boats; motor cargo boats, rigid hull inflatables, skiffs, TANBs, landing craft, etc., the particular craft chosen to meet the specific need. In areas where landing is not practical using a "standard" boat, where there is a large rise and fall of tide, or where mud flats extend for a long distance from shore, aids are often worked with a small inflatable boat. Either paddles or a small outboard motor can be used for propulsion. The rubber boat has been found useful for working around rocky or coral shorelines.

4. Hoisting Rigs. Various methods are used to haul equipment up marine structures or to the site of shore aids. Luff tackles of 21-thread are used at many structures where batteries are housed well above the ground or on a marine foundation. Round bar davits are installed on some aids while at others the tackle must be secured where possible. Carefully inspect the frame of the structure, or wherever the tackle is to be made fast, before hoisting. A common place for making fast is at the intersection of the tower cross braces. Keep crew members from passing under suspended loads. Hard hats are required when working any aid to navigation.

5. Handling Batteries.

a. Batteries may be carried in canvas packs slung over the back. No more than 2 batteries should be carried in each pack. The packs allow full use of the hands and arms in scaling the path to the lights, holding on to rocks, lines, branches, etc. When transporting batteries always leave the plastic bags on to prevent spilled acid in case of a fall.

b. Batteries should be hoisted in a bucket or box on a line, never by the carrying handles. Polyethylene line should be used for battery handling tasks because of its resistance to acid.

c. To prevent batteries from "shorting out" in driven rain or snow, place them as far as possible from the door.

d. BE EXTREMELY CAREFUL IN HANDLING AND DISPOSING OF ALL BATTERIES. Consult the latest Commandant or District Instruction(s) on the disposal or return of exhausted batteries.

e. Proper gear shall be worn when handling batteries (i.e., goggles, gloves, hard hats, rain gear).

f. Solarization has helped reduce the need for hauling a large number of batteries and for the frequent recharging of most lights. The Coast Guard's goal is to convert as many lights as possible to solar power, so it makes good sense to convert those lights in remote locations as soon as possible.

6. General Servicing Procedures for Shore Lights.

a. When a shore aid is serviced, the following minimum steps should be accomplished:

(1) Check the initial voltage of the batteries and while under load.

(2) Replace batteries as needed.

(3) Check the wiring, including megging, throughout the structure.

(4) Check the flasher and lamp changer, changing lamps if necessary.

(5) Check the voltage output and diode on the solar panel(s). Check the panels for damage and cleanliness and ensure that they are facing south.

(6) Clean and inspect (including leveling and focusing) the lantern assembly.

(7) Check the structure for leaks. If leaks are found make repairs if possible; if not, submit an SSMR for additional support.

(8) Make those repairs that are within the capabilities of the work party.

(9) Clear away brush and trees obscuring the light and daymark.

b. Comply with all requirements of COMDTINST M16500.3 (series) *Aids to Navigation Manual - Technical*.

c. When painting towers or other elevated structures wear a safety belt and hard hat.

Safety climbs are required on towers over 20 feet. On larger structures where a safety climb is not practical, a Bos'n Chair lowered from the top of the structure may be more effective..

7. Inspecting for Repairs.

   a. When visiting a structure ashore, make a thorough inspection of the buildings, tower, and accessories. Take any necessary action to correct defects within the capabilities of the personnel and equipment available. Make a full and detailed report including a list of materials required, sizes and dimensions, for those repairs not made. Submit either an SSMR or work request via the chain of command. Since the Civil Engineering Unit (CEU) may not be able to visit the site, 35mm pictures, or a video tape, of the problems should be included with the SSMR. See CHAPTER 14 of COMDTINST M16500.7 ATON Manual - Administration.

   b. Document any vandalism. Make reports on vandalism as specified in CHAPTER 7 of COMDTINST M16500.7 ATON Manual - Administration.

D. Records.

1. Problem Aids. Vessels should maintain a file of those aids that often present problems in boarding and may be inaccessible during certain weather conditions. An example of a typical entry may be:

   Example: Harbor Island Warning Light, LLNR 3420, Atlantic Coast Light List, Vol. II. This light is located on the remains of an old screw pile lighthouse marking the entrance to Core Sound, North Carolina. Shallow depth (4' at MLW) requires the use of a small boat (either TANB or ship's boat) and should not be worked when the winds are in excess of 20 knots from the NW or SW as considerable sea and swell will be encountered. A metal boarding ladder on the SE side of the structure allows access to the light. The metal wreckage of a former structure (visible at all tides) is located 30 yards NE of the structure. Wreckage of a WWII airplane lies 1/4 mile due south of the light in 3' of water. This wreckage is not visible at any stage of the tide and is considered a hazard to small boats.

2. Data. Data on boat moorings, depth of water, protruding bolts, rocks, etc., are very useful and should be included in the aid folder for future use. Photographs are invaluable and should be included in all aid folders.

CHAPTER 12: AIDS TO NAVIGATION TEAMS

A. Buoy Boat Operations.

1. General. Aids to Navigation boats are small boats designed to service aids in shallow or restricted waters. They range in size from the 21' TANB to the 63' ANB, and can handle most unlighted buoys as well as some of the smaller lighted buoys. Due to its size the 21' TANB is limited to the smaller unlighted buoys. Larger lighted buoys may be recharged or serviced alongside. The buoy boat's hoisting capacity will not permit bringing them aboard. There are three basic types of ATON boats: those that work aids off the side (i.e., TANB), those that work aids off the bow (i.e., BU), and those that work aids off the stern (i.e., BUSL).

2. Safety. The safety precautions and practices contained in this Manual for the larger ATON vessels apply to the smaller ATON boats. Extreme care must be taken to prevent the boat from capsizing either from the current or excessive weight on one side. Gear must always be properly secured. Additional safety procedures are discussed later in this chapter.

3. Power Driven Weight Handling Equipment.

   a. Working loads of power driven weight handling equipment and the authorized number of parts in the purchases for each capacity are listed in chapter 573 of the Naval Engineering Manual (NEM, COMDTINST M9000.6 - series). This instruction also lists the reference drawings for standard and alternate rigs. Unauthorized changes to the rigging shall not be made. Units are authorized, with the approval of the District Commander, to use fewer parts in the purchase than shown in the NEM if the working capacity of the new rig is reduced accordingly. An example: if a 4-part purchase, 1 ton capacity is the standard rig, a 2-part purchase would be authorized if the capacity was reduced to 1/2 ton. Label plates shall be installed on all buoy boat booms to show the authorized maximum working load in pounds with the corresponding number of parts in the purchase.

   b. All hoisting gear shall be inspected before beginning the day's work. Check for broken or frayed lines, loose pins, leaking hydraulic system, etc. A more through examination shall be made weekly. Guidelines for conducting annual inspections are contained in the NEM. All power machinery shall be inspected and maintained as described in the manufacturer's instructions.

B. TANB Buoy Working Procedures and Precautions.

1. General. The TANB is a Trailerable Aids to Navigation Boat. As such it is a highly mobile resource capable of responding to floating, fixed and shore outages when launched from a boat ramp nearest the aid. This boat is not intended for transits in open water, transits in areas when the seas are more than 4 feet, or operations in surf. If these conditions are present the TANB is not to be used until the conditions improve and shall not respond until it is safe.

2. Working Buoys. More and more the TANB is being used to service the smaller plastic buoys in shallow waters that are not accessible to the ANT's larger boats. Several methods have been devised to lift the small sinkers with the TANB. One way is to have two people lift each end of a metal bar (that has a hook in the middle) hooked into the chain and pull the mooring and sinker up and then into the boat. This system is considered dangerous because it puts the weight of two crewmembers, the sinker and mooring on one side of the boat. If the sinker is sanded, or mudded, it is almost impossible to lift it by muscle power alone. An alternate method is to drag the sinker(s) to the nearest boat landing where they are pulled out of the water with the unit's truck and then manhandled into the truck or stored for future use. The latest method, and most preferred, is the use of a 500-pound capacity davit mounted on the aft starboard side of the TANB with an installed 12-volt electric winch. This method is much faster and safer if simple safety precautions are followed.

3. TANB Davit Precautions. When using a TANB davit the following precautions must be strictly observed to prevent accidentally capsizing the TANB or injuring personnel.

   a. TANB davits must be weight tested annually to 500 pounds. The weight and date of the test must be stenciled on the davit. Results must be entered in the Boat Record.

   b. Sinkers shall not be stacked on top of one another in the boat or on the gunwale.

   c. The largest sinker, or other weight, that may be lifted with the davit is 300 pounds.

   d. At no time is the combined weight of the cargo (ATON material), boat outfit including the davit, and crew to exceed 2,500 pounds. Exceeding the safe capacity of the boat and/or exceeding the safe working load of the davit is the quickest and surest way to get into trouble.

   e. Weight is to be distributed evenly to maintain a stable platform.

   f. The davit shall not be used when seas exceed one foot.

   g. The davit and chain stopper/pelican hook shall not be used to free a mudded or sanded sinker.

   h. Do not attempt to drag or tow buoys, sinkers or another vessel with a fully loaded TANB.

   i. When working buoys keep the boat's bow headed into the wind or current, whichever is stronger. If at all possible do not attempt to work buoys during periods of maximum flood or ebb current conditions. If you must work buoys during these conditions it may be better to anchor to keep your bow into the current. Whenever working buoys the engine should be kept running, and the coxswain must be alert to keep the boat headed into the current or waves.

4. TANB Davit Procedures.

   a. A three-man crew is required when working small buoys with the TANB. One acts as coxswain, one operates the hoisting gear, and the other assists in hoisting and handling the load as necessary. Because of the TANB's limited stability and working space, buoys should be stored to one side as much as possible. Buoys and other appendages must be secured to prevent shifting and injury to personnel or damage to the boat.

b. TANB davits have only one hoisting tackle which requires that after each lift the chain must be stopped off and a fresh bight taken. A simple chain stopper (i.e., pelican hook, or single leg sling with hook) led over the side may be used. Regardless of which method is used, some means of protecting the TANB gunwale and side must be used (i.e., old dayboards).

c. The unlighted buoys may be hoisted as follows:

   (1) Hook the hoisting purchase into the lifting lug on top of the buoy and pull it aboard. Steady the buoy while the chain is stopped off below the mooring shackle. Then lower the buoy to the deck to unshackle.

   (2) Unshackle and secure the buoy. Hook the purchase into the mooring chain as low as possible and hoist, casting off the stopper as the strain is taken on the purchase. This procedure may be have to be completed numerous times before the sinker is aboard.

   (3) If a sinker is sanded-in, attach the chain to the towing bitt and use the engine rather than the hoisting gear to break it out. Remember to keep the boat's bow into the current and pull the sinker out by going ahead. The practice of "laying back" or riding on the downstream side of the sinker is extremely dangerous. If the sinker does not come free after moderate tugging with the boat, dump it. No sinker is worth risking the crew and capsizing a boat.

   (4) If the sinker is to be used again, inspect it for damage, attach the new mooring, and secure it to the gunwale.

d. Setting Buoys.

   (1) The mooring should be made up in the proper length with one end of the chain shackled to the sinker and the other end connected to the buoy. Once near the charted position, place the buoy over the side, secured to the amidships cleat with a piece of line. The chain is ranged out on the gunwale, or on the sinker, in such a manner as to prevent it from hanging up when the sinker is set. The sinker is hoisted and set on the gunwale and "set" by pushing it over the side.
   Note: Some units do not shackle the chain to the sinker until the sinker is resting on the gunwale.

   (2) It is easier to locate AP and set a "marker buoy" before setting the buoy. After the buoy is set the position is rechecked and if needed the buoy can be dragged to AP. Once on station the buoy is cast off from the TANB.

e. Recharging Buoys on Station. TANB davits shall not be used to recharge buoys. However, personnel can carry a chain fall or come-a-long, which when attached to the tower of a large buoy can be used to hoist batteries out of the buoy pocket. This procedure should only be used if a hot-pack will not suffice or if recharging will be delayed indefinitely by the servicing tender. Ideal weather conditions are required before attempting to recharge buoys with a TANB.

C. Working Buoys with the 45' BU.

1. General. The 45' BU is a bow loading, single screw buoy boat of 1950 design. The boats have a pivoting A-frame hydraulic boom controlled by two hydraulic rams and two hydraulic winches, one for the main purchase, the other for a crossdeck. Lifting capacity of the boom is 4,000 pounds. The wire rope for the main runs along the port side to a heel block near the base of the boom. From the heel block it runs up to the center of the A-frame where it passes through a wire rope block.

   a. The 45' BU's well deck has a cargo capacity of 16,800 pounds. A butterfly chain stopper is mounted on top of a chain roller on the bow. The chain stopper rotates 180 degrees and is locked in the upright position by a manual locking device on the starboard side.

   b. Controls for the boom, main purchases and crossdeck are located inside the pilothouse on the port side. Hydraulic power for the main and crossdeck is supplied by the main engine. During buoy evolutions, the engine speed is limited to 1000 RPMs.

   c. Because of the open bow and well deck the seakeeping ability of the 45' BU is not considered especially good. A removable metal spray shield fitted onto the bow helps to reduce water intake. The use of a tight-fitting canvas, angled so water runs over the side, will also help prevent water from collecting in the well deck.

   d. If water does collect in the well deck, pump it out immediately. The hazard lies not in the weight of the water as much as it does in the danger of the free surface effect of the constantly moving water which may capsize the boat.

   e. All loads carried or worked in the well deck must be secured. Because of the round bottom, considerable boat movement will result from even a small boat wake. If a BU is riding a mooring servicing an aid, any movement of an aid in the well deck can endanger personnel because of the lack of escape routes. BUs carrying a deck load have become imperiled and started taking on water when unsecured cargo shifted.

   f. When approaching a buoy, the boat should be headed into the wind or current, whichever is stronger. It may be necessary to find a heading that is most maneuverable (easiest to hold the boat on station,) if the current and wind are from different directions. Because of the sail area, round bottom and lack of engine power the boat is difficult to handle and requires the constant attention of the coxswain.

2. Hoisting Buoys. When approaching a buoy, the hydraulic system should be on the line, and the chain stopper laid back toward the well deck with a line attached to pull it into place. The crossdeck should be laid out and ready, the boom should be tilted

forward and the forward safety chain should be up. Personnel should not lean over the bow and get between the vessel and the buoy.

a. Hooking the main into a buoy can either be done by guiding the hook, holding onto the wire rope or the preferred method of using the reeving line hook. After hooking, slightly raise the buoy and mouse the hook.

b. The safety chain must always be in place if personnel are cleaning or making attachments to a buoy still outside the boat. The one exception is the attachment of the crossdeck. Once the buoy has been moused and cleaned the safety chain is removed.

c. The buoy is then lifted to clear the bow. Some buoys worked by the BU are too long to fit easily on deck and the boom will have to be retracted to help them clear. On lighted buoys, the crossdeck is hooked into the same lifting eye as the main and is pulled back into the well deck. This also serves to pull enough chain so the buoy can be set on deck and disconnected. On unlighted buoys, the crossdeck should be connected to the chain at the bottom of the buoy.

d. To place the stopper in the upright position a crew member pulls on the rope attached to the stopper and sets the locking device. The chain is then hit with a maul to insure it's seated.

e. With the crossdeck and main purchase still hooked into the buoy, a crew member enters the well deck to disconnect the buoy.
Note: Connecting or disconnecting a buoy is the most dangerous evolution on a 45' BU; crewmembers must place themselves between the buoy and buoy port when hooking and unshackling.

f. Immediately after unshackling the buoy be sure it's secured. Now the chain can be brought to short stay if needed.

g. To recover the mooring, ("pulling chain") attach the main to the chain forward of the chain stopper for the first pull. The boom has been tilted forward, the crossdeck has been led forward, and the safety chain has been removed.

h. The chain is then raised and the boom is retracted to help with the pull and to angle the chain into the chain stopper. If the chain will not fall into the stopper, attach the crossdeck and pull the chain while slacking off on the main. If the sinker is to be retrieved, this process is repeated until the sinker is raised high enough to attach the main purchase.

i. After the main is attached to the sinker and raised, the crossdeck is attached to the sinker bale. The boom is retracted while the crossdeck is kept taught. When the boom is fully retracted the sinker is lowered into the well by slacking off on the main and keeping the slack out of the crossdeck.

j. If the mooring is being brought to short stay for a mooring inspection, or when dragging the sinker to position the aid, the chain is secured with a shackle to one of the padeyes in the well deck. The safety chain is then put up.

k. When setting or recovering lighted buoys always use the picking bale. This allows the bridle to lay flat when passing the buoy over the bow.

3. Setting Buoys.

a. The sinker is hung over the bow on the chain stopper. Put the chain over the bow, stopping it off with a shackle to a well deck padeye.

b. Move the vessel as close to station as possible. The placement of a marker float on the AP is the preferred and quickest way to establish where the buoy is to be set. Once you are on AP set the sinker.

c. Once the sinker is set attach the mooring to the buoy. Move the buoy to the bow with the hoisting whip, and the crossdeck run through a snatch block forward, and hooked into the mooring padeye.

d. When the buoy is at the bow, move the crossdeck to the lifting padeye to act as a preventer. Move the buoy out over the bow, release the crossdeck, and trip the chain stopper. Lower the buoy until it is floating, disconnect the main and back away.

e. Recover the marker float and stow all gear or get ready for the next aid.

4. Recharging Buoys on Station. Buoys may be recharged by tying off to the buoy at the bow using the main purchase to hoist batteries out of the buoy.

D. Working Buoys with the 46' BUSL and 63' ANB.

1. General. Both the 46' BUSL and 63' ANB are both stern-loading buoy boats designed with buoy decks aft for more space and with A-frames located on the stern. They differ in other respects but the basic deck layout and operation is essentially the same.

a. There are two classes of the 46' BUSL. The first class, consisting of boat numbers 46300 - 46306, are limited to a 3,000 pounds safe working load with both whips. The second class, consisting of boat numbers 46307 - 46315, have a safe working load of 4,000 pounds. The cargo capacity of both classes is 16,800 pounds.

b. The 46' BUSL uses an integrated hydraulic buoy handling system consisting of two A-frames and two jib booms, each of which work in unison with the other. In addition, the boat has two boom winches and a deck winch, which work independently.

c. The 46' BUSL has a Shottle drive (combination rudder and propeller) system which provides excellent maneuverability.

d. The 46' BUSL can relieve floating aids up to and including a 5X11 lighted buoy, or up to a second class unlighted buoy. A sinker size of 3,000 or 4,000 pounds (depending on the class of boat) and up to 1 inch chain can be handled.

e. Because this is a stern-loading boat you must back into the current or wind to work buoys. When making the approach, retract the jibs and extend the A-frame. The chain stop should be in the locked position and the crossdeck led out to aid in a rapid hookup.

2. Hoisting the Buoy. The preferred method of hooking onto a buoy is with a reeving line hook. This will avoid having a crewmember lying on the deck and reaching down to attach the buoy.

   a. Hook both whips to the buoy and lift the buoy high enough to clear the chain stopper and attach the crossdeck.
   Note: Whip hooks should be placed opposite each other during all lifts.

   b. Extend the A-frame to the forward position, while keeping the load as close to the deck as possible. The chain will fairlead into the chain stopper and the chain stopper will automatically engage when the buoy is slacked off or lowered. Use a maul to ensure that the chain is properly seated in the chain stopper.

   c. After the chain is set in the chain stopper, lower the buoy to the deck and disconnect the chain from the buoy. Move the buoy from the work area using the crossdeck and secure it.

   d. To pull chain, use the crossdeck and continue to pull chain until the mooring is at short stay. Slack off the crossdeck line, and seat the chain in the chain stopper using the maul.

   e. At this point, if the sinker is to be pulled on deck, the A-frame is moved aft and the whips are positioned to pull the chain. Use the crossdeck as necessary to seat the chain in the chain stopper.

   f. As each bight of chain is pulled the jibs are extended, the A-frame is extended and the whips are brought up to pull the chain into the chain stopper. If the chain does not fall into the chain stopper use the crossdeck to pull it in and then slack off on the whips.

   g. The process is repeated until the sinker is at the surface. Move the A-frame outboard, until the sinker will clear the stern, and then raise with the whips.

   h. Lift the sinker until it just clears the chain stopper. Then extend the A-frame forward and lower the sinker to the deck.

3. Setting a Buoy.

   a. Position the sinker and buoy on deck.

   b. Extend the A-frame rams and extend the jib booms until the whips are centered over the sinker. Attach the whips to the sinker's pigtail and lift the sinker slowly, just high enough to clear the chain stopper, keeping equal strain on both whips.

   c. Retract the A-frame rams and jib booms to clear the sinker over the stern.

   d. Lead the chain into the chain stopper and slowly lower the sinker over the stern far enough to let it hang below the bottom of the boat. Make sure the chain is set in the chain stopper and the chain stopper is properly locked.

   e. Unhook the whips.

f. Extend A-frame rams and center the whips over the buoy.

g. Hook the whips into the buoy and lift it slowly until it clears the deck.

h. Retract the A-frame rams and move the buoy over the stern. Lower the buoy until it is one-third into the water, keeping excess chain lashed on deck.

i. Maneuver the boat to position, trip the chain stopper, lower the buoy and release the whip and pull away. Another method of setting a buoy with a pelican hook is to:

(1) Rig a pelican hook assembly, consisting of a Herc-alloy bridle and a pelican hook, attached to one or more deck padeyes. Determine the proper amount of chain required to set the buoy, and secure the chain by the pelican hook. Fake out the remaining chain on deck and hook the buoy to the mooring chain.

(2) Extend the A-frame and whips over the buoy lifting bales. Ensure that the buoy is still griped to prevent rolling, for unlighted buoys.

(3) Maneuver the boat to the buoy's AP using a marker float as a reference. Check the position of the boat to ensure that the sinker is on AP.

(4) When you are satisfied the boat is on AP, hook the whips into the buoy and lift it slowly until it clears the deck.

(5) Retract the A-frame and move the buoy over the stern. Lower the buoy by the whips until it is one-third in the water.

(6) When everything is ready to set the buoy. The buoy may be lowered into the water and the hooks removed. Once the hooks are retrieved, the safety pin is removed from the pelican hook. Upon the command "let go," the pelican hook is tripped and the buoy is clear.

(7) Recover the marker float and stow all gear or get ready to work the next aid.

(8) If it is necessary to drag the sinker, bring the sinker to short stay. Place the chain in the chain stopper and rig a pelican hook to the chain for reinforced support. Ensure that there is a sufficient bight in the chain inboard of the pelican hook to allow the buoy to be hooked up, and for setting. Attach the buoy to the chain after the sinker is on assigned position and set the buoy.

4. Recharging Buoys on Station. When recharging buoys on station, the lighted aid is pulled tight and chained into the stern notch. Then the battery pack is removed and replaced, using the whips, jibs and A-frame to lift the batteries out of the pocket and place them on deck. The reverse is done to recharge the buoy.

E. Working Buoys with the 55' ANB.

1. General. The 55' ANB was conceived as a fast response aids to navigation boat for responding to offshore fixed and floating aid outages. Over time the 55' ANB has

evolved into a buoy working platform. It is not well suited for this mission because of limited deck capacity, weight handling capability and lack of an installed chain stopper. The 55' ANB's limit for safe transit are seas of 5 to 6 feet. The ANB should not be used to work floating aids in seas greater than 3 feet.

a. There are three different types of cranes on the 55' ANB. The vessels with the M45 Huskey crane (installed on boats 55101 - 55112) are limited to 2,000 pounds safe working load up to 13' reach and 1,000 pounds beyond 13 feet. The second group of vessels with the M45 Huskey crane (boats 55113 - 55119) have a safe working load of 3,000 pounds up to 13' reach and 2,000 pounds beyond 13 feet. The last group (boats 55120 - 55122) have a 3,300 pound lifting capacity. The cargo capacity of all 55' ANB's is 4,000 pounds.
Note: (1) Maximum safe working loads are calculated for each class over the stern "notch." (2) All three crane types are scheduled to be replaced with an Alaskan Model 4-20 crane.

b. The 55' ANB has two deck-mounted winches for use as crossdecks.

c. A drop bar (screw guard) located at the stern protects the twin propellers from danger when working buoys.

d. Controls for the articulated crane, winches and engines are located on a pedestal on the port side behind the deck house.

e. Because this is a stern-loading boat you must back into the current or wind to work buoys. When making the approach, fully extend the jib and raise the boom so the block is centered over the notch at the stern of the boat. The drop bar should be down. One crossdeck should be led out, and a pelican hook (to serve as the chain stopper) and a single leg with a grab hook should be ready on deck.

2. Hoisting a Buoy. The preferred method for hooking onto a buoy is to utilize a reeving line hook. This will avoid having a crewmember reaching down to attach the hook to the buoy.

a. Keep the safety chain up while hooking the buoy.

b. Once the buoy is hooked, heave around on the main until the buoy is far enough out of the water to safely mouse the hook. Then remove the safety chain and raise the main and boom up as necessary to get the buoy on deck.

c. Attach a crossdeck to the buoy and heave around until enough chain is aboard to place in the pelican hook and then disconnect the buoy. The chain should always be in the pelican hook before disconnecting the buoy. Never rely on a grab hook for this evolution.

d. Once the buoy has been disconnected, move it out of the way and again extend the boom with the jib all the way up so it centers over the chain for the next pick.

e. When the main is hooked into the chain, heave around just enough so the pelican hook can be tripped. At this point you must decide what you intend to do with the mooring. If the sinker is to be brought aboard, move the pelican hook out of the way and lead the single leg sling with the grab hook aft.

f. Because of the danger of chaffing, a nylon sling should not be used. A chain sling works best. To save time, the sling can have a pear-shaped link with several different sizes of grab hooks attached. This sling is attached to the base of the crane pedestal. Heave around on the main and boom up as necessary to take a pick of chain, slack off on the main and take another pick.

g. Continue "picking chain" until the sinker is lifted aboard.

h. If the sinker is being brought to short stay, use the grab hook only until the final pull. Then use the crossdeck to pull the chain into the pelican hook and secure the chain. Never ride or drag a sinker without the chain being secured in a pelican hook. The grab hook is only a temporary device to hold the chain between pulls. It is not a long-term securing device.

3. Setting a Buoy.

a. Position the sinker and buoy on deck. Leave enough slack in the chain to set the buoy over the stern, below the bottom of the aft deck. Be sure to secure it to the pelican hook.

b. Lift the sinker over the stern and lower it below the edge of the aft platform deck. The drop bar will protect the screws.

c. Stop off the chain with rottenstops, leaving enough chain on deck to set the buoy.

d. Lead the chain into the pelican hook and slowly lower the sinker over the stern far enough to let it hang at or slightly below the aft deck. An extra long pigtail helps in unhooking. Make sure the chain is set in the pelican hook and that the pelican hook is properly positioned.

e. Unhook the main.

f. Hook the buoy and lift it slowly until it clears the deck.

g. Lower the buoy until it is one-third into the water, keeping the excess chain lashed on deck.

h. Maneuver the boat to the AP, which has been previously located and marked with a float. Trip the pelican hook, lower the buoy and release the main and pull away.

i. If the sinker is left at short stay, and it is necessary to drag the sinker to position, recommend the chain be left in the pelican hook and the buoy be attached only after the sinker is on AP. Then the buoy is attached and set as outlined above. You will need to ensure that there is enough chain on deck to allow for a bight in the pelican hook and enough slack to set the buoy in the water.

j. Often it is necessary to drag buoys to their assigned position after they have been set. This is easily accomplished by tying the buoys off with a large line and dragging them. Because of the protection afforded the rudders and screws by the drop bar, this evolution is carried out at the stern of the boat.

4. Recharging Buoys on Station. When recharging buoys on station, the buoy is pulled into the stern notch. One way to accomplish this is to run a line through the buoy

padeyes and secure them to the aft deck bitts. On some ANBs, the winches have been replaced with wire rope winches. When using these winches, attach a section of synthetic or manila line to the wire rope and pass it through the buoy padeye and then to the aft deck bitts. This line will act as a shock absorber and prevent the winches from being damaged in a surge. Then the battery rack is removed and replaced using the main purchase.

F. Towing Buoys with Small Boats.

It is an accepted practice to tow buoys (both lighted and unlighted) with Coast Guard boats. This often saves the time and expense of getting a large tender underway to move a buoy a few hundred yards or less. The coxswain should be aware of several precautions before attempting to tow any buoy, among which are:

1. General. Never attempt to tow any buoy unless you know the weight of the sinker, and the size and length and type of mooring. This information can be obtained from the unit which has the primary or secondary responsibility for the buoy. Likewise, do not attempt to tow a buoy that is too large for the boat (i.e., do not attempt to tow an 8X26 with a TANB). Normally, those buoys you will be attempting to tow will be those that have been moved off station due to a recent storm, or drug off by a passing vessel. If the sinker is either sanded or mudded it is very doubtful if you will be able to move the buoy.

2. Find the AP. Before trying to move the buoy find the AP and mark it with a marker buoy. This will serve to provide a heading for you to steer toward. Always use the towing bitts for towing and tow from the lifting bail of the buoy.

3. Situational Awareness. Be aware of the direction the buoy mooring is leading and where your towline is to prevent them from getting into your screws or rudder. It's always a good idea to have an ax or hatchet available to cut the towing hawser in case of trouble.

4. Safety. During the attempt to move the buoy, ensure that your crew is protected by the towing screen (if boat is so equipped), in the cabin, or provided some form of protection if the towing line should part. At anytime during the towing evolution, if you feel you cannot safely tow the buoy, then STOP! Towing the buoy back to its AP, or refloating it from the beach, is not worth personal injury or damage to the boat. If you feel you cannot safely do it, then do not do it!

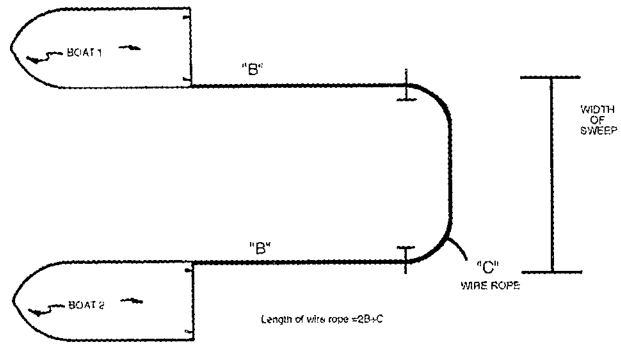
G. Wire Sweeping with Small Boats.

1. General. Whenever a structure has been destroyed (i.e., ice, collision, etc.) the wreckage must be located and recovered at the earliest possible opportunity. If not recovered, or adequately marked, it's a hazard to navigation and puts a severe liability burden on the Coast Guard. The unit assigned servicing responsibility for the aid is also required to ensure that the wreckage is located and the location marked with either a TRUB, TRLB or other appropriate buoy. The most reliable way to locate submerged wreckage is by wire sweeping the area with either one or two small boats. The following methods are the ones most commonly used.

a. Wire Sweeping with Two Boats. This consists of two boats running parallel courses at slow speed with either a wire cable (normally 1/4" - 3/8") or small chain (3/16" - 1/4") strung between the boats. The wire cable, or chain, dragging the bottom will hang on the obstruction, stopping the movement of the boats. After the boats have pulled back to the location of the wreckage, they then pass one end of the cable (both ends have eye splices) through the other eye and tighten the cable. The cable is then buoyed with a small marker float, or TRUB/TRLB, and left for the construction tender to recover. The tender will either utilize the cable to recover the wreckage or as an aid to pass a larger wire or chain around the wreckage before recovery (See **Figure 12-1**.)

b. Wire Sweeping with One Boat. When using one boat, the boat either tows a grapnel over the search area or utilizes a trawl board wire sweep rig. The preferred method (and the one that covers more bottom area and has a better chance to locate the wreckage) is the trawl board method. This rig consists of two small wooden or metal trawl boards, similar to those used on commercial fishing boats, towed behind the boat on a bridle. These "boards" are weighted so they will sink to the bottom and are attached to the bridle in such a manner that when pulled they are forced apart, thus providing an opening of approximately 20 feet between the boards. A small wire rope cable (i.e., 1/4") approximately 60' long is stretched between the boards and will drag the bottom hanging on the wreckage. After the wreckage is located (normally by the boat being stopped), the boat then pulls back to the boards and the wire cable is disconnected from the boards. One eye of the cable is then passed through the other and pulled tight. Like the two boat method, a small marker buoy, or TRUB/TRLB, is attached to the end of the cable. When the construction tender arrives to rebuild the aid, she will use the wire to assist in recovering the wreckage (See **Figure 12-2**.)

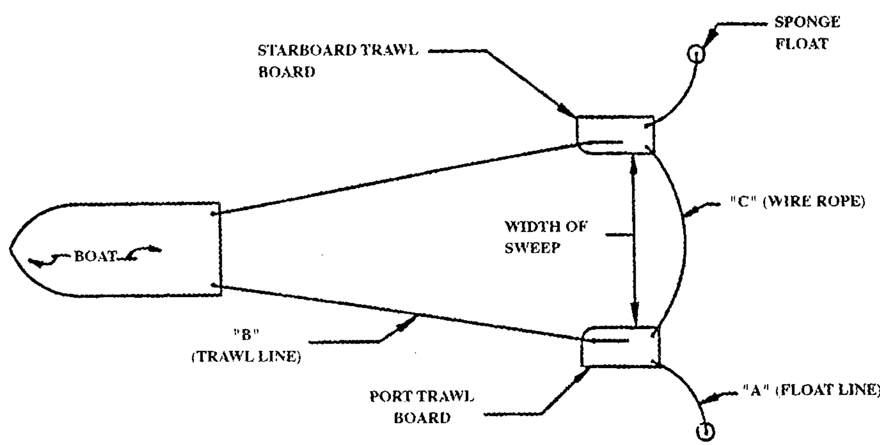
2. Overview. When using either method of wire sweeping, be both patient and persistent. While there is a chance that a wooden aid may float away after it's knocked down, it may have broken above the mudline leaving a stump that can cause severe damage to a vessel striking it. There is never any doubt where the remains of a steel or concrete structure are--they're on AP. Your job is to find them. It's not uncommon to search for hours, or even days, for a downed structure. In most cases the structure can be located, either on AP, or if it's wooden, it may have drifted to a nearby shore. It cannot be said too often, or emphasized too strongly, that we must employ every method at our disposal to locate and remove the wreckage of destroyed ATON structures.



WATER DEPTH	WIDTH OF SWEEP	"A"	"B"	"C"
UP TO 14'	35'	25'	100'	50'
UP TO 14'	60'	25'	125'	75'
UP TO 20'	35'	35'	125'	50'
UP TO 20'	60'	35'	150'	75'

LINE "A" - FLOAT LINES (3/8" HEMP OR SYNTHETIC)
"B" - TRAWL LINES (3/8" TO 1/2" HEMP OR SYNTHETIC)
"C" - WIRE ROPE (3/16" DIA.)

Fig. 12-1 Wire sweeping with 2 boats



WATER DEPTH	WIDTH OF SWEEP	"A"	"B"	"C"
UP TO 14'	35'	25'	100'	50'
UP TO 14'	60'	25'	125'	75'
UP TO 20'	35'	35'	125'	50'
UP TO 20'	60'	35'	150'	75'

LINE "A" - FLOAT LINES (3/8" HEMP OR SYNTHETIC)
"B" - TRAWL LINES (3/8" TO 1/2" HEMP OR SYNTHETIC)
"C" - WIRE ROPE (3/16" DIA.)

Fig. 12-2 Wire Sweeping with one boat

CHAPTER 13: LIGHTHOUSE RESTORATION AND LOGISTIC SUPPORT

A. General.

Because of the isolated locations of many light stations, water transportation is often the only way to provide logistics and maintenance support. Buoy tenders and boats are often tasked with providing this support. During these operations they often encounter hazardous wind and sea conditions and difficult moorings or anchorages. As in all ATON operations, safety must be the operator's prime consideration. The risk to vessel and crew, and the possibility of an oil spill or cargo loss, do not justify working in dangerous or even marginal conditions. On logistics runs, patience is truly a virtue.

B. Approaching the Station.

1. Soundings. Get as close as possible to the unit being serviced. This is especially true for fueling, watering and restoration operations. Until you gain familiarity with the area, however, exercise caution in the approach. Thoroughly sound the area, using a crew member with a leadline deployed in a small boat and a depthsounder if available. The leadline is preferred because it allows the leadsman to feel large rocks. Use objects on the structure, pier, beach, etc., to help you develop a chart including water depths. Be sure to compare this with the largest scale chart of the area. If necessary, set up marker buoys to mark a safe channel and use natural ranges. The approaches to some locations are ideal and can be used under most conditions. More often, locations can be approached only from certain angles, and visits are affected by wind and tidal state. Eddy currents often develop around some exposed offshore structures; they should be taken into consideration when making an approach. Proper evaluation is the result of numerous, carefully observed visits to each location. Keep unit notebooks of each aid, recording each visit. This information will prove to be invaluable to future crews visiting the aid.

2. Anchoring. Take care if the vessel must anchor when providing fuel or water. Changes in tide or current may cause the ship to swing and the hose could foul itself on the anchor chain or even part. In some locations the servicing ship can anchor close to the beach and pass a sternline ashore. The stern can then be warped in as close as practical to the beach.

3. Single-screw Vessels. When servicing offshore towers, keep the receiving station off the port bow. If it becomes necessary to back off quickly, the bow will swing clear. Tenders should not moor alongside offshore towers but should anchor close by.

4. Approaching Stern-to. In some cases, a fueling vessel will experience less yawing in heavy weather by laying stern-to the relieving station. If there is a tendency to creep up on the receiving station, a vessel laying stern-to can turn its engines slightly to maintain separation. Extreme care must be taken when approaching the shore in this manner.

C. Providing Fuel and Water.

1. General. Deliver fuel and water by using a hose with the servicing vessel's transfer pumps normally providing the moving force. Other systems employing compressed air or booster pumps have been used. These methods are often more productive than the ship's transfer pumps. The ship's pumps were not designed to pump over long distances or up high elevations. However, using compressed air can be dangerous if proper precautions are not observed. The light station tanks must be inspected and tested prior to each fuel transfer to ensure that they can withstand the pressures involved. If booster pumps are used to deliver fuel, they must be the non-sparking type.

2. Inspect the Hose. Hoses should be visually inspected for leaks or chafing before use. Hoses reserved for portable water should never be used for any other purpose, especially pumping fuel oil. Hoses should be hydrostatically tested annually. The hose is then capped and put under light air pressure to check for leaks. While still under pressure, the hose can be floated to the station using a messenger line. Some units tie floats along the hose to ensure that it will continue to float, and thus reduce the possibility of snagging on underwater obstructions. Since it is almost impossible to detect a hose leak in the water after dark, fueling at night is not recommended.

3. Communications. Communications with the unit receiving fuel or water are very important. Soundings should be taken continuously. The operation should be monitored closely so the servicing vessel can be directed to stop pumping immediately if a leak, overflow, or other emergency takes place.

4. Blow Down Hose. Once pumping is finished, the hose must be blown down with compressed air to empty the line. During blow down, take care to prevent spillage of any oil. Pumping must be secured before topping off the tank to allow room for the fuel or water that is to be blown from the hose. The hose should then be capped, to prevent pollution or seawater contamination of the hose, and hauled back aboard the servicing vessel.

D. Camels and Fenders.

1. Camels vs. Fenders. When a ship lays alongside a structure there is often enough swell to cause battleship fenders to collapse. Camels constructed using 8" X 8" X 12' timbers run through the center of numerous discarded automobile tires have proven quite resilient. The camel is hung over the side using the ship's boom.

2. Foam Fenders. Foam fenders, made from the same foam material as the foam buoys, will take a great deal more punishment than battleship fenders.

E. Barges and Cranes.

Barges are the best platform for performing restoration work on offshore lights. They provide a large stable platform for carrying supplies and holding air compressors, forklifts, etc. Barges can often be obtained at no charge from Army Corps of Engineers and Navy Reserve Units. These barges are sometimes equipped with cranes that can be used effectively to lift old tanks and other gear being removed from or placed on the structure. All lift gear on barges should be thoroughly inspected and tested before use.

F. Helicopters.

Helicopters have been used very effectively in the installation of lights and removal of equipment in areas where a boat or shore transportation cannot be used. Reserve and National Guard units often have access to Skycranes and Chinook helos that they use for heavy lift operations. They are quick to assist us, as their operations allow, and while they're getting additional training we're getting the job done. We should foster a good relationship with these units. Their services have proven invaluable in servicing offshore work.

G. Sandblasting.

1. General. With recent changes in pollution laws, sandblasting on light structures has become very controversial. Some states require all sandblast grit used to be collected and returned for disposal as a hazardous waste. These regulations vary from state to state, with some states having no regulations. Whenever a project involves sandblasting, a thorough understanding of the regulations is needed. Your local Civil Engineering Unit (CEU) and state Environmental Protection Agency will provide the information you need. If used grit must be collected for disposal, all permits needed should be "in hand" before the work starts.

2. Personnel. Personnel who sandblast must have adequate protection. Helmets with a filtered air supply are highly recommended as well as heavy long-sleeve coveralls and gloves. Do not allow personnel to blast without a blasting helmet and air filters.

3. Safety Supervisor. Personnel who are sandblasting should have a safety supervisor assigned. As with all restoration projects, an EMT should be readily available for emergencies.

4. Planning. Restoration projects should not be a cost versus safety issue. If scaffolding is needed for the safety of the workers, then borrow, rent or purchase it. Items like scaffolding, ladders, air compressors, etc., can be used again and are often shared between units.

5. Type of Grit. Sandblast grit comes in many types and sizes. Each is designed for a particular use. Know the surface you're going to blast and what type and size of grit is recommended. Using the wrong grit can destroy, or damage, the surface, particularly on brick structures. Silica sand, beach sand, and glass beads are not authorized because they can cause a lung disease known as silicosis.

H. Removal of Fuel Storage Tanks.

Removal of old fuel storage tanks is quite often regulated by the states or other local agencies. Tanks above ground or exposed in a basement have fewer restrictions. Underground tanks often require a more thorough inspection. If leakage and pollution occur during the removal it can quickly become a public issue, regardless of the size of the spill. It is recommended that all such removals be coordinated with the nearest CEU.

I. Asbestos Surveys and Removal.

Removal of asbestos should not be attempted by Coast Guard personnel, unless they are properly certified. If asbestos is present and needs to be removed, conduct an asbestos survey and submit an SSMR for removal to the local Shore Maintenance Detachment (SMD) via your chain of command.

J. Battery Cleanup.

Old battery dump sites on Coast Guard property are classed as hazardous waste sites in most states. The Coast Guard is in the process of identifying these sites and collecting these batteries. Before collecting, transporting, or disposing of batteries, consult the local CEU or MLC hazardous waste disposal expert. Some areas have contracts to collect and dispose of old batteries.

K. Historical Site Preservation

Many Coast Guard lighthouses are listed as eligible for the National Register of Historical Places. Prior to any significant work at a historical site it may be necessary to obtain approval from the State Historical Preservation Officer (SHPO). Significant work involves removal of buildings, replacement of items such windows, railings, etc. Major projects should be coordinated through the District Aids to Navigation Branch and the CEU for possible historical import.

APPENDIX

180′ WLB

LOA: 180′ **BEAM:** 37′ **DISPLACEMENT:** 1,029 Tons

CREW: (Off/CWO/CPO/ENL) 5-2-4-38 (inconus except D9); 5-2-4-37 (D9); 5-2-4-46 (OCONUS)

DRAFT: Full Load: 11′8″fwd, 13′7″aft / Minimum Ops: 10′9″fwd, 12′9″aft

MACHINERY PLANT: Single screw - 5 blade bronze (except those with reinforced hulls for icebreaking which may have stainless steel).

2 - EMD 8-645E6 diesel engines with 1200 SHP (EXCEPT SUNDEW which has 1800 SHP) electric motor.

Bow thruster with GM 6-71N diesel direct drive. Austere Renovated WLBs do not have a bow thruster.

Electrical system: 120/208v AC 3 phase

LIFT CAPACITY: whip: 5t; 3-part: 15t; 5-part: 20t*

With permission of the District Commander, some WLBs are authorized NOT to test the 5-part rig, thus limiting their maximum capacity to 15t using the 3-part rig.

HOOK HEIGHT AT DECK EDGE: Whip: 34′; Main: 21′6″

BUOY PORT FREEBOARD: 7′ aft end of buoy port, at 12′ draft.

CARGO CAPACITY: 53 Tons. (There is no set capacity between the main hold and deck. What can really be carried depends upon the displacement of the cutter at the time and the need to keep the kg in the safe range. Original design called for a cargo capacity capability of 100 Tons (space available has never permitted this), but ships were 2-compartment vessels at that time. The more weight that can be placed in the #2 hold the better but especially on Major Renovations/SLEPs this is a limited space as well. The Austere Renovated WLBs have two holds #1 and #2 capable of stowing cargo. Major Renovations have minimal heavy stowage capability in the #1 Hold because of the bow thruster space located in the lower portion of the hold. SLEPs do not have a forward (#1) hold.

BUOY DECK AREA: (sq ft) 1600

TRANSIT SPEED: Max speed/range: 13kt/4500 miles; Eco speed/range: 7.5kt/13,500 (except SUNDEW 8.0kt/16,000 miles, 15.0kt/5200 miles) (ref: G-ENE-1 facilities data sheet)

Fuel consumption is 95 g/hr at Max speed and 21 g/hr at economical speed. Because of the wide range of fuel capacities, the range of each cutter varies.

TRANSIT ENVIRONMENT: Open sea

SERVICE (WORK) ENVIRONMENT: 4-6 foot seas max. Wind not exceeding 20kts and current not exceeding 2 kts.

ENDURANCE:

Fuel: 27,875 (Major Ren and SLEP); 49,400 (Austere Ren).

Water: 30,500 g (Major Ren and SLEP) Several vessels have varying capacities ranging from 13,152 (WOODRUSH) up to 53,870 (IRONWOOD, IRIS)

Gray water: (MAJREN) 100 g; (SLEP) 275 g; (AUSREN)

Sewage: (MAJREN) 2000, (SLEP) 1900

Capable of round-the-clock steaming.

Provisions for up to 21 days with water making capability. Eight days for vessels without water making capability.

GENERAL DESCRIPTION: The WLB is considered to be a multi-mission vessel. Due to its endurance and offshore seakeeping capabilities, the WLB is tasked to perform non-ATON related missions, particularly when bad weather and rough conditions make it hazardous for smaller vessels. This is particularly true in D17 where the extended coast line and weather conditions often make the WLB the only available resource for performing a variety of missions. Capable of handling the largest Coast Guard buoys and primary resource for deploying the large offshore data-collection buoys used by the National Data Buoy Center.

SMALL BOATS ASSIGNED: The small boat allowance varies from ship to ship depending upon their location and demands. For the WLB fleet the allowance is as follows:

MSB	MCB	RHIB	RHIM	RHIL
02	22	23	10	09

SPECIAL CAPABILITIES: Five cutters (SPAR, COWSLIP, ACACIA, BRAMBLE, SUNDEW) have reinforced hull plating for icebreaking from the 8′ water line to the keel, in addition to the reinforced hull plating from the normal waterline to the 8′ waterline that all WLBs have.

The following cutters have either evaporators (E) or reverse osmosis systems (RO) IRIS(E), FIREBUSH(E), IRONWOOD(E), PLANETREE(E), SEDGE(E), SWEETBRIER(E), WOODRUSH(E), CONIFER(RO), BASSWOOD(RO). All other WLBs have NO water making capabilities. Nine cutters (D14 and D17) have long range communications packages on board.

SPECIAL LIMITATIONS: WLBs have a roll period of 7.9sec with full load and 9.9sec with minimum op load. Buoys cannot be worked in conditions that equal or exceed these parameters.

NUMBER OF CLASSES: 01 (9-SLEP, 13-Major Ren, 4-Austere Ren)

NUMBER OF EACH CLASS, TOTAL NUMBER: 26

CLASS DIFFERENCES AFFECTING CAPABILITIES: Water making and stowage capabilities differ dramatically between the vessels and between the LANT and PAC areas.

157′ WLM

LOA: 157′ BEAM: 33′ DISPLACEMENT: 556 Tons

CREW: (Off/CWO/CPO/Enl) 3-2-2-28

DRAFT: Full load: 6′fwd, 6′7″aft / Minimum Ops: 4′4″fwd, 6′4″ aft

MACHINERY PLANT: 2-Cat D398A diesel reduction gear engines developing 1800 SHP. Bow thruster and lifting rig are powered by hydraulic pumps driven off the main diesel engines.

Electrical system: 440v AC 3 phrase

LIFT CAPACITY: Whip: 4t; Main: 10t

HOOK HEIGHT AT DECK EDGE: Whip: 36′6″; Main: 24′5″;

BUOY PORT FREEBOARD: 4′ aft end of buoy port with ship's draft at 6′.

CARGO CAPACITY: 25 Tons. There is no capacity for splitting the load between the hold and deck. (Ref: Stability and Loading Book)

BUOY DECK AREA: 1200 sq ft

TRANSIT SPEED: Max speed/range: 12.8/2248 miles; Eco speed/range: 11.6/3055 miles

TRANSIT ENVIRONMENT: Open ocean transits in relatively calm weather only, seas to 6-8 ft. Short roll period leads to extreme fatigue and dangerous accelerations in conditions not threatening to stability.

SERVICE (WORK) ENVIRONMENT: Protected and semi-protected waters. Capable of open water operations in good weather only where seas do not exceed 2-4 feet and swells are minimal.

ENDURANCE:

Fuel: 17,742 gals

Water: 15,666 (RED CEDAR, RED OAK)

20,516 gals (RED BIRCH, RED WOOD, RED BEECH)

Gray water: Gray water may be diverted to the sewage tank.

Sewage: 1020 gals.

Capable of round-the-clock steaming.

GENERAL DESCRIPTION: WLMs are focused-mission vessels devoting the majority of their time to the SRA mission. Its limited sea keeping abilities restrict off-shore work and the ATON they service are generally smaller than those serviced by the WLB. There are two types of WLM, the "Red" class consisting of 5 cutters and the "White" class consisting of 6 cutters. Each class is addressed separately as WLM-157 or WLM-133.

SMALL BOATS ASSIGNED: The small boat allowance varies from ship to ship depending upon their location and demands. For the WLM fleet (includes both WLM-157 and WLM-133) the allowance is as follows:

MSB	MCB	RHIB	RHIM	RHIL
00	00	00	07	02

Some vessels are also authorized as a UTL; these are Non-standard boats and vary from district to district.

SPECIAL CAPABILITIES: Icebreaking up to 18″ with continuous progress in ice up to 6″.

SPECIAL LIMITATIONS: Limited side-loading of the boom due to the pinion gear taking the strain versus the topping lift. Stiff hull form results in dangerous accelerations limiting offshore work. Endurance is limited to 3 days in areas where gray water cannot be discharged. Can handle mixed gender crews only with officers. There are no facilities which would permit the assignment of enlisted females on board either WLM-157 or WLM-133.

NUMBER OF CLASSES: 2

NUMBER OF EACH CLASS, TOTAL NUMBER: Red: 5, White: 6

CLASS DIFFERENCES AFFECTING CAPABILITIES: None within 157 class, but substantially limited seakeeping when compared to the 133 class.

133′ WLM

LOA: 133′ **BEAM:** 31′ **DISPLACEMENT:** 485 Tons

CREW: (Off/CWO/CPO/ENL) 0-1-2-21

DRAFT: Full load: 8′5″ fw, 5′7″ aft / Minimum ops: 5′10″ fwd, 7′1″ aft

MACHINERY PLANT: Twin screw. 2- Caterpillar D353D direct drive diesel engines direct drive developing 660 SHP total.

Electrical system: 450v AC 400 amps 3 phase (M5441.5I)

LIFT CAPACITY: Whip: 4.0; Main: 10t

HOOK HEIGHT AT DECK EDGE: Main: 24′; Whip: 35′.

BUOY PORT FREEBOARD: 3′6″aft end of buoy port with draft at 7′6″.

CARGO CAPACITY: Full load 30 Tons and minimum op 20 Tons respectively, these capacities will permit a 10 ton lift over the side during buoy ops. There is no capacity for splitting the load between the hold and deck. The more that is placed in the hold the better.

BUOY DECK AREA: 1000 sq ft

TRANSIT SPEED: Max speed/range: 10.3/2100 miles; Eco speed/range: 9.2/4300 miles (G-ENE-1 facilities data sheet)

TRANSIT ENVIRONMENT: Protected, semi-protected and open ocean in good weather.

SERVICE (WORK) ENVIRONMENT: Protected, semi-protected waters. Capable of open waters during good weather.

ENDURANCE:

Fuel:	12,300 gals;
Water:	9,630 gals.;
Gray water:	350 gals;
Sewage:	880 gals.

Capable of round-the-clock steaming for short periods. Provisions for up to ten days endurance. Sewage and gray water are limiting factors in no-discharge zones.

GENERAL DESCRIPTION: WLMs are focused-mission vessels devoting the majority of their time to the SRA mission. Their limited seakeeping abilities restrict off-shore work and the ATON they service are generally smaller than those serviced by the WLB.

There are two types of WLM, the "Red" class consisting of 5 cutters and the "White" class consisting of 6 cutters. Each class is addressed separately as WLM-157 or WLM-133.

SMALL BOATS ASSIGNED: The small boat allowance varies by ship depending upon location and demand. The fleet allowance for the WLM-157 and WLM-133 is as follows:

MSB	MCB	RHIB	RHIM	RHIL
00	00	00	07	02

SPECIAL CAPABILITIES: Deeper draft and rounded hull form provides easier motion and allows limited offshore work in good weather.

SPECIAL LIMITATIONS: Limited side-loading of the boom due to the pinion gear taking the strain versus the topping lift. There are no facilities which would permit the assignment of females on board the WLM-133 except as CO. The use of reversing gears and absence of bow thrusters limit maneuverability. These vessels do not have ice plating or framing.

NUMBER OF CLASSES: 2

NUMBER OF EACH CLASS, TOTAL NUMBER: Red: 5, White: 6

CLASS DIFFERENCES AFFECTING CAPABILITIES: CGC White Pine has installed spuds.

65′ WLI

65300 Class - CHOKEBERRY and BLACKBERRY

LOA: 65′4″ **BEAM:** 17′ **DISPLACEMENT:** 68 Tons

CREW: 9

DRAFT: Full load, 4′10″; Minimum ops, 3′6″

MACHINERY PLANT: 1 GM 8V-71N (MDE), Single screw FPP, 5 blade, 39″ diameter, 39″ pitch, bronze

Electrical System: 2 GM 2-71 SSDG (30KW)

LIFT CAPACITY: 4,000 LBS.

HOOK HEIGHT AT DECK EDGE: 12′

CARGO CAPACITY: HOLD - 2500 LBS; DECK - 11,000 LBS

TRANSIT SPEED: ECONOMICAL - 5 KTS; MAX - 9 KTS

TRANSIT ENVIRONMENT: Sea conditions 3′, protected or semi-exposed areas only.

SERVICE ENVIRONMENT: 1′-2′ max. seas for work.

ENDURANCE: Fuel: 600 NM (max), 1300 NM (econ). Other limiting factors: 5 days. Food and sewage limiting factors.

GENERAL DESCRIPTION: The 65′ WLI is a steel-hulled inland buoy tender constructed in 1946. It is used to service 5x11 Lrs, 3rd class unlighted buoys and smaller and structures in protected environments. Capable of overnight steaming, although both ships generally pull in at night. They carry 660 gal. water and 962 gal. fuel.

SMALL BOATS ASSIGNED:

BLACKBERRY	1 TANB*, 1 WP - OMC GAS 1/40HP O/B
CHOKEBERRY	2 TANB*

*Used for fixed ATON servicing, not carried on deck

SPECIAL CAPABILITIES: None.

SPECIAL LIMITATIONS: Cannot accommodate mixed gender crews.

TOTAL NUMBER: 2

65′ WLI

65400 Class BAYBERRY and ELDERBERRY

LOA: 65′4″ **BEAM:** 17′ **DISPLACEMENT:** 83 Tons (BAYBERRY)
78 Tons (ELDERBERRY)

CREW: 6 (ELDERBERRY); 15 (BAYBERRY)

DRAFT: Full load, 4′8″; Minimum ops, 3′9″

MACHINERY PLANT: 2 GM 4-71 (SSDG-40KW), 2 8V-71 (MDE), Twin screw FPP, 3 Blade, Diameter 44″, Pitch 44″, Bronze

LIFT CAPACITY: 4,000 LBS.

HOOK HEIGHT AT DECK EDGE: ELDERBERRY, 17′; BAYBERRY 10′ (ship), 32′ (barge)

CARGO CAPACITY: HOLD - 2500 LBS; DECK - 11,000 LBS

TRANSIT SPEED: ECONOMICAL - 5 KTS; MAX - 9KTS

TRANSIT ENVIRONMENT: Operates in large semi-exposed inland waterways, straits, sounds, inlets, rivers and bays. One cutter (BAYBERRY) tows a barge astern in Puget Sound and pushes it above the locks. Maximum seas for safe transit 5′.

SERVICE ENVIRONMENT: Largest sea state capable of working in: 2′ (ELDERBERRY), 1′ (BAYBERRY w/barge). Capable of 5x11 buoys and smaller.

ENDURANCE: Fuel: 600 NM (max), 1500 NM (econ). Other factors: 4 days. Sewage and fatigue are the limiting factor.

GENERAL DESCRIPTION: The 65′ WLI (65400) is a steel-hulled inland buoy tender constructed in 1954. It is used to service buoys and structures in protected environments. Capable of overnight steaming, although both ships generally pull in every night. There are three fuel tanks (fwd. and cent. - 680 gal., aft 645 gal.) and two water tanks (515 gal. each)

SMALL BOATS ASSIGNED: BAYBERRY - 1 TANB*, 1 RHIB 18′

ELDERBERRY - 1 WP 16′

*Not carried on ship's deck

SPECIAL CAPABILITIES: BAYBERRY's hull has been modified to accommodate a barge both pushing ahead and towing astern. Capable of relatively open water (large straits, sounds) transits in calm seas.

SPECIAL LIMITATIONS: Cannot accommodate mixed gender crews. If the sea state is greater than 3′, BAYBERRY must tow astern. Difficult and dangerous to hook up underway, but necessary for ATON work, mooring and anchoring. Buoy barge has only one chain stopper, all buoys worked starboard side to.

TOTAL NUMBER: 2

NUMBER OF CLASSES: 65300 - 2; 65400 - 2

CLASS DIFFERENCES: 65300 Class have pneumatic topping lifts, hand powered vangs and single screws. 65400 class have an extra bulkhead at frame 6 and twin screws. ELDERBERRY has a hydraulic crane, BAYBERRY has a pneumatic crane (which will be replaced by a hydraulic one in August '97) and a 60′ x 20′ buoy barge (60044) equipped with hydraulic crane. The barge is connected to BAYBERRY by wires and steamboat jacks. Special reinforcements have been added to its hull for this purpose.

100' WLI

LOA: 100'6" **BEAM:** 24' **DISPLACEMENT:** 226 Tons (BLUEBELL)
174 Tons (BUCKTHORN)

CREW: (Off/CWO/CPO/ENL) 0-1-2-12

DRAFT: Full load: 5'6"; Minimum Ops: 4'

MACHINERY PLANT: 2 CAT D353D (MDE), Twin Screw FPP, 5 Blade, Diameter 46". Pitch 46", Bronze (BLUEBELL); 3 Blade Diameter 44", Pitch 37", Bronze (BUCKTHORN)

Electrical System: 2 (3 on BUCKTHORN) GM 4-71 SSDG (50KW)

LIFT CAPACITY: Whip, 1 Ton (BUCKTHORN), 2 Tons (BLUEBELL); Main, 5 Tons

HOOK HEIGHT AT DECK EDGE: 24' (Main) 24'6" (Whip)

CARGO CAPACITY: HOLD - 6000 LBS; DECK - 50,000 LBS

TRANSIT SPEED: ECONOMICAL - 8.5; MAX - 10 KTS

TRANSIT ENVIRONMENT: BUCKTHORN Operates in the Great Lakes in seas up to 5-6' generally in protected waters. BLUEBELL works in a river environment. The seas are generally 1-2', max transit environment is 5-6'.

SERVICE ENVIRONMENT: BUCKTHORN is restricted to calm weather buoy handling only. It works in the Great Lakes with 3' seas max for AtoN operations. BLUEBELL works in the rivers and the max seas are 4'.

ENDURANCE: 1200 NM (max). BUCKTHORN - 5000 gal. fuel, 3600 gal. water, 3 days due to lack of food storage. All other limiting factors (water, sewage, fatigue) would last for 7 days. BLUEBELL is limited by sewage capacity to 10 days. Other limiting factors would last for 14 days.

GENERAL DESCRIPTION: The 100' WLI (C) is an inland buoy tender used to service up to second class buoys in the Great Lakes. It has a steel hull with an aluminum pilothouse and upper deckhouse. It also has one centerline spud to assist with positioning. Cutter is operated in a fresh water area. Salt water operation would require an availability to replace steel fittings with bronze. The 100' WLI (A) is an inland buoy tender which is assigned 6x20 LB and smaller; however, a 7x17 LB is within its capability. It generally works in a river environment. Due to its large sail area, BLUEBELL has difficulty operating in high winds.

SMALL BOATS ASSIGNED: BLUEBELL - 1 SKI 14', 1WP 18'
BUCKTHORN - 1 WP 14'

SPECIAL CAPABILITIES: Capable of pushing a barge if desired.

SPECIAL LIMITATIONS: Cannot accommodate mixed-gender crews.

TOTAL NUMBER: 2

NUMBER OF CLASSES: A - 1; C - 1

CLASS DIFFERENCES: Although both BLUEBELL and BUCKTHORN are 100′ WLIs, they are different. BLUEBELL is essentially a 100′ WLIC without the barge or hammer and its sister ships are SMILAX, RAMBLER, and PRIMROSE. BUCKTHORN is essentially its own type of ship. It has a centerline spud and 360 degree rotating boom.

BUCKTHORN posses an articulating hydraulic crane which can side load to some extent (tested to 5,000 lbs). Crane tip is swivel equipped.

BLUEBELL has a pneumatic crane which will be changed to hydraulic during the August 1993 yard period. The new crane will have a 6,000 lbs. capacity whip and will retain its 10,000 lbs. main.

160′ WLIC

LOA: 160′10″ **BEAM:** 30′ **DISPLACEMENT:** 459 Tons

CREW: (CWO/CPO/ENL) 1-2-12

DRAFT: Full load - 5′fwd 5′6″ aft / Minimum Op - 3′6″fwd 4′aft

MACHINERY PLANT: 2 - Caterpillar D379 diesel engines with 500SHP/engine, Twin screws - 4 bronze blades, diameter 48″, pitch 44″

Electrical system: 440v AC 3 phase

LIFT CAPACITY: Whip - 4.125t; 2-part - 8.25t

HOOK HEIGHT AT DECK EDGE: Whip - 70′; 2-part - 67′

CARGO CAPACITY: Deck - 30.1 ton; Hold - 5.2 ton

TRANSIT SPEED: Economical - 9.6kts; Max - 11kts

TRANSIT ENVIRONMENT: Can transit open waters in up to 4′ seas.

SERVICE (WORK) ENVIRONMENT: Depth to spud 25′ (max) 15′ normal depending on bottom type, max seas 2′

Used to construct minor aids to navigation structures and drive pile for dolphins, daymarks, and piers. Must be spudded for construction ops.

ENDURANCE:

Ranges:	A Class	-1380 nm at 11kts deep water>12′
		-1116 nm at 9.6kts shallow water < 12′
	B Class	-3440 nm at 11kts deep water >12′
		-1116 nm at 9.6 kts shallow water < 12′

Capacities:	A Class	B Class
Fuel	6,349 gal	16,266gal
Potable Water	3,558gal/13,714gal	6,612gal FW
	16,710 ballast/trim RW	

Logistically limited to 7-8 days underway without a port call due to fresh water supply with grey water discharged over board.

GENERAL DESCRIPTION: Inland Construction Tenders (WLICs) are operated in the harbor and harbor entrance environment to construct fixed ATON structures in shallow water where bottom conditions are appropriate to accept driven piles. They also service medium size buoys and moorings. The 160′ WLICs are capable of traversing exposed water and have shallow drafts. The WLICs are responsible for construction minor aids to navigation structures. To perform their specialized tasks, WLICs are outfitted with uniquely suited pile driving equipment and spuds. Construction tenders are called upon to perform all manner of construction work such as driving piles, erecting a variety of minor structures, both ashore and on marine sites, and pulling out damaged or broken piling which might constitute a hazard to navigation. Although most of the work is done in protected waters, they are sometimes called upon to work ATON located in inlets or large inland bays. Unlike the other classes of WLIC, the 160′ WLIC is a single unit rather than a tug and barge configuration.

SMALL BOATS ASSIGNED: 1 - WP

SPECIAL CAPABILITIES: CONSTRUCTION - Can drive 60′ piles. The cutter boom is capable of servicing second class can and nun buoys and 5′x11′. Cutter is equipped with four spuds, and can remain absolutely stationary in shallow, calm water.

SPECIAL LIMITATIONS: The lattice type construction crane is susceptible to damage with greater than 2% side loads; needs to be spudded down when constructing structures; cannot accommodate mixed-gender crews.

NUMBER OF CLASSES: 2

NUMBER OF EACH CLASS, TOTAL NUMBER: 2, 4

100′ WLIC

LOA: 100′6″ **BEAM:** 24′ **DISPLACEMENT:** 226 Tons (Cutter)

LOA: 68′/70′ **BEAM:** 30′

CREW: (CWO/CPO/ENL) 1-2-11

DRAFT: Full load - 4′6″ Min Op - 4′

MACHINERY PLANT: 2 Caterpillar D353D diesel engines with 330SHP/engine, twin screws - 5 bronze blades, diameter 46″, pitch 46″

Electrical system: 120/208v AC 3 phase

LIFT CAPACITY:

(Cutter)	Whip - 1 ton	5-part - 5 ton
(Barge)	Whip - 4.125 ton	2-part - 9 ton

HOOK HEIGHT AT DECK EDGE:

(Cutter)	Whip - 34′	4-part - 27′
(Barge)	Whip - 57′	2-part - 55′6″

CARGO CAPACITY: Deck - 10 ton Hold - 10 ton

TRANSIT SPEED: Economical - 8.5 kts; Max - 10.5 kts

TRANSIT ENVIRONMENT: Cutters without barges can transit open waters in up to 4′ seas. Barges are restricted to calm weather in ICW, bays, river and other protected waters.

SERVICE ENVIRONMENT: Depth to spud 20′ (max) 15′ normal, max seas 1′

Barges used to construct structures and drive pile for dolphins, daymarks, and piers. Barges can be spudded and work independently from cutter.

ENDURANCE:

Range: 1300 nm at 8.5 continuous steaming

Capacities:	Cutter	Barge
Fuel	3,834 gal	3,135 gal
Potable Water	3,302 gal	
	2,000 gal (peak tank non-potable)	

Logistically limited to 7 days underway without a port call due to sewage holding tanks and potable water supply.

GENERAL DESCRIPTION: Inland Construction Tenders (WLICs) are operated in the harbor and harbor entrance environment to construct fixed ATON structures in shallow water where bottom conditions are appropriate to accept driven piles. They also service medium size buoys and moorings. The 100′ WLICs are capable of traversing exposed water when operating independently of the barge and have shallow drafts. The WLICs are responsible for construction and complete servicing of small marine structures.

SMALL BOATS ASSIGNED: 1-ANB, 1-TANB, 1 - WP

SPECIAL CAPABILITIES: CONSTRUCTION - Can drive 60′ piles, converts from pushing a barge configuration to a buoy servicing configuration in less than 30 minutes. The cutter boom is capable of servicing second class can and nun buoys and 5′x11′. Two of this class push a barge with 2 spuds on cutter and 2 spuds on barge. The third tender is equipped with an A-frame pile driving hammer on the bow.

SPECIAL LIMITATIONS: The lattice type construction crane is susceptible to damage with greater than 2% side loads; needs to be spudded down when constructing structures; cannot accommodate mixed-gender crews.

NUMBER OF CLASSES: 1

NUMBER OF EACH CLASS, TOTAL NUMBER: 3

CLASS DIFFERENCES AFFECTING CAPABILITIES: CGC PRIMROSE is not equipped with a barge, but has an A-frame pile driving hammer installed on the bow of the cutter. This enables PRIMROSE to service aids in more confined waterways within her AOR.

75' WLIC

LOA: 76′1″ **BEAM:** 22′ **DISPLACEMENT:** 145 Tons (Cutter)

CREW: (CPO/ENL) 3-10 (USCGCs SLEDGE and VISE have 1 CWO)

DRAFT: Full load - 4′; Min Op - 4′

MACHINERY PLANT: 2 - Caterpillar D353E diesel engines with 375SHP/engine, twin screws - 5 bronze blades each, diameter 44″, pitch 50″

Electrical system: 440v AC 3 phase

LIFT CAPACITY: Whip - 4.125 ton 2-part - 9 ton

HOOK HEIGHT AT DECK EDGE: Whip - 57′ 2-part - 55′6″

CARGO CAPACITY: Deck - 10 ton Hold - 10 ton

TRANSIT SPEED:

	Economical	Max
A Class	5.0 kts	8.8 kts
B Class	5.0 kts	9.1 kts
D Class	5.0 kts	9.4 kts

TRANSIT ENVIRONMENT: Restricted to ICW, bays, rivers and other protected waters. Tug's stability is dependent on the barge being attached to the tug. Tug receives Fuel and Water from the barge storage tanks.

SERVICE ENVIRONMENT: Depth to spud 20′ (max) 15′ normal, max seas 2′. Spud length 30′ to 40′ depending on AOR. Some barges have 2 spuds and some have 3.

Barges used to construct structures and drive pile for dolphins, daymarks, and piers.

ENDURANCE:

Ranges:	A Class	B Class	D Class
	1300 nm at 8.8 kts	1000 nm at 9.1 kts	1050 nm at 9.4 kts
	2400 nm at 5.0 kts	2200 nm at 5.0 kts	2500 nm at 5.0 kts

Capacities:	Tender	Barge
Fuel	3,150 gal	2,214 gal
Potable Water	1,500 gal	1,500 gal

Logistically limited to 7 days underway without a port call due to sewage holding tanks and fresh water supply.

GENERAL DESCRIPTION: Inland Construction Tenders (WLICs) are operated in the harbor and harbor entrance environment to construct fixed ATON structures in shallow water where bottom conditions are appropriate to accept driven piles. They are equipped with a 68′ barge used for construction operations. They also service medium-size buoys and moorings. The 75′ WLICs are not capable of traversing exposed water due to stability limitations of the tug.

SMALL BOATS ASSIGNED: 2 - WP, Some also have 1 - TANB

SPECIAL CAPABILITIES: CONSTRUCTION - can drive 60′ piles, equipped with PUSH KNEES. Capable of servicing second class can and nun buoys and other buoys up to 6′X20′LRs. Able to carry pollution response equipment such as skimmers, booms, pumps, and damage control and salvage equipment.

SPECIAL LIMITATIONS: The lattice type construction crane is susceptible to damage with greater than 2% side loads; needs to be spudded down when constructing structures; cannot accommodate mixed-gender crews. Restricted to protected waters.

NUMBER OF CLASSES: 3

NUMBER OF EACH CLASS; TOTAL NUMBER: 2, 3, 4; 9

CLASS DIFFERENCES: CGC SLEDGE has a 65′ crane vice 60′ as does the rest of the class.

115′ WLR River Tender/138′ ATON Barge

LOA: 115′5″ **BEAM:** 30′ **DISPLACEMENT:** 390 Tons (Cutter)

LOA: 138′ **BEAM:** 32′ **DISPLACEMENT:** 507 Tons (Barge)

CREW: (CPO/ENL) 3-19

DRAFT: 7′6″

MACHINERY PLANT: 3 - Caterpillar D379TA diesel engines with 750SHP/engine, 3 screws - 4 Stainless Steel blades each diameter 64″, pitch 40″

Electrical system: 440v AC 3 phase

TRANSIT SPEED: Economical 5.0 Maximum 10.6

TRANSIT ENVIRONMENT: Generally restricted to riverine environment. Transit of protected ICW possible when required, sea conditions should be strictly limited to less than 1 ft. due to barge interface system. The 115 WLR is weight critical and gains operational stability from the ATON barge it pushes; the WLR should not be moved when uncoupled except in controlled or emergency situations.

SERVICE ENVIRONMENT: Restricted to riverine environment, shallow water operation, the WLR has an installed spud mooring system. Sea conditions should be strictly limited to less than 1′. Routine intentional groundings to service shore ATON. The western river system is dredged to a minimum 9 ft. channel depth.

ENDURANCE:

Ranges: -5,000 nm @ 10.6 kts

-11,600 nm @ 5 kts

Capacities:

Fuel -21,180 gal

Potable Water -5,500 gal

Able to support the crew for approximately 15 days. Onboard stores of water and fuel are supplemented by barge mounted storage tanks. Additional dry stores and freezer space also located on barge. Limited by sewage holding capability of approx 1,000 gal.

GENERAL DESCRIPTION: USCGC SUMAC is a one of a kind River Buoy Tender (WLR). In mission and capabilities, it does not differ greatly from other WLRs. It is the last of a class of older WLRs which has been replaced by 75′ WLRs. The pusher boat is of the flush deck, barge hull type with a model type, spoon bow. Transverse framing construction has been used throughout. SUMAC's hull is divided into various watertight compartments, due to vessel age and modifications; watertight integrity between compartments is marginal; because of age the age of the vessel no action is being taken to correct these discrepancies. Electric power is supplied by two 60 KW diesel generator sets wired for single or parallel operation. Electrical power for the barge is taken from the pusher boat by means of suitable jumpers. Power for the electric-hydraulic Alaska crane is supplied by a separate generator on the ATON barge.

SMALL BOATS ASSIGNED: 2 - WP, 1 - Munson, 1 - TANB

SPECIAL CAPABILITIES: Equipped with push knees. SUMAC is equipped with 4 flanking rudders, 3 steering rudders and propeller access plates to clear obstructions without divers or drydocking. Is capable of changing out steering rudders without drydocking.

SPECIAL LIMITATIONS: CGC SUMAC cannot currently accept mixed gender crews. Due to her size, age, and configuration, the assigned crew is larger than other vessels with the same mission. SUMAC gains additional stability from her ATON barge and should not transit open water.

NUMBER OF CLASSES: 1

NUMBER OF EACH CLASS, TOTAL NUMBER: 1

138' ATON BARGE

DRAFT: @ full load displacement: 4 Ft.

MACHINERY PLANT: No propulsion machinery. Barge is equipped with a GM 3-53 Engine to drive the installed air compressor. The barge generator is an Allis-Chalmers model 670T powering an Onan 100 KW generator. The Alaska crane has an electric hydraulic unit powered by the barge generator. The barge generator supplies power for the electric-hydraulic crane only; all other power is supplied by the tender.

Capacity:

Fuel - 3,480gal.

Water - 25,842gal.

Cargo - > 75tons

LIFT CAPACITY: Alaska hydraulic crane is currently Coast Guard rated at 2,000 Lb safe working load. This rating is currently in the process of being increased by G-ENE to 3,000 Lb. safe working load.

75′ WLR River Tender/ATON Barge

	C Class	E Class	F Class
LOA:	75′5″	75′5″	75′9″
BEAM:	22′	22′	24′
DISPLACEMENT:	150 Tons	150 Tons	172 Tons

CREW: (CPO/ENL) 3-10

DRAFT: Full Load - 4′2″

MACHINERY PLANT:

C Class: 2 - Caterpillar D353D diesel engines with 330SHP/engine*, twin screws - 4 blades each, diameter 47″, pitch 43″

E Class: 2 - Caterpillar D353E diesel engines with 375SHP/engine, twin screws - 4 blades each, diameter 48″, pitch 43″

F Class: 2 - CATERPILLAR 3412-DIT turbocharged diesel engines with 503SHP/engine, twin stainless steel screws - 6 blades each, diameter 46″, pitch 51″

Electrical system: 120/240v AC

*As yard time and funding permit, 75C WLRs are being upgraded to 375 HP Configuration.

TRANSIT SPEED: Economical 6.5, Max 7.6-10.5, dependent on horsepower and tug/barge combination

TRANSIT ENVIRONMENT: Generally restricted to riverine environment. The 75C WLR is marginally under powered. Transit of protected ICW possible when required, sea conditions should be strictly limited to less than 1 foot due to barge interface system. A 75′ WLR gains its stability from the ATON barge it pushes, the WLR should not be moved when uncoupled except in emergency situations.

SERVICE ENVIRONMENT: Restricted to riverine environment, shallow water operation, the WLR has an installed spud mooring system. Sea conditions should be strictly limited to less than 1′. Routine intentional groundings to service shore aids. The western river system is dredged to a minimum 9 ft. channel depth.

ENDURANCE:

Ranges:	C Class	E Class	F Class
	1600 nm at 8.7kts	1600 nm at 7.6kts	1600 nm at 12.0kts
	3100 nm at 6.5kts	3100 nm at 6.5kts	3100 nm at 9.25kts

Capacities:	E Class	F Class
Fuel	2,986 gal.	3,438 gal.
Potable Water	2,882 gal.	2,573 gal.

Note: C Class range values have not been updated since the larger 130′ barge replaced original WLR barges.

Able to support the crew of 14 for approximately 15 days. Onboard stores of water and fuel are supplemented by barge mounted storage tanks. Additional dry stores and freezer space also located on barge. Limited by sewage holding capability of approx 900 gal.

Operation is generally limited to daylight hours (sunrise-sunset) day buoy ops, with occasional night transit steaming.

GENERAL DESCRIPTION: River tenders (WLRs) - all found in CGD2 - are operated on inland rivers and are responsible for construction and servicing of shore structures, and servicing of floating ATON. These vessels are all pusher tugs with barges. The pusher boat is of the flush deck, barge hull type with a model type, spoon bow. Transverse framing construction has been used throughout. The hull is divided into five watertight compartments consisting of the trim tanks and a void at the bow; a forward hold; engine room; an after hold and lazarette. The hull is of steel construction. Because the barge is entirely separate from the tug, and a number of types of barges are in use, there is no single "standard" configuration for a WLR. This description may be taken to apply to all WLRs, with minor variations. Electrical power for the barge is taken from the pusher boat by means of suitable jumpers.

SMALL BOATS ASSIGNED: A mixture of FRs, WPs, and UTLs

SPECIAL CAPABILITIES: Equipped with push knees. The 75 WLRs are equipped with flanking rudders and propeller access plates to clear obstructions without divers or drydocking. They are capable of changing out steering rudders without drydocking. The 75F WLRs are equipped with 4 automated flanking rudders and two steering rudders. 75C Class WLRs push 130′ ATON Barges. 75E Class WLRs push 100′ ATON Barges, 75F Class WLRs push 130′ Barges. Refer to 130′ or 100′ ATON BARGE for additional info.

SPECIAL LIMITATIONS: The 75′ C and E Class WLRs cannot currently accept mixed-gender crews. The 75F WLRs are designed to accept mixed-gender crews. All 75′ WLRs lack stability when not coupled to their barge and should not transit open water.E

NUMBER OF CLASSES: 3

NUMBER OF EACH CLASS; TOTAL NUMBER: 5, 4, 2; 11

65′ WLR River Tender/ATON Barge

LOA: 65′10″ **BEAM:** 21′ **DISPLACEMENT:** 145 Tons

CREW: (CPO/ENL) 3-10

DRAFT: A Class, 4′6″; B Class 5′

MACHINERY PLANT:

A Class: 2 - Caterpillar D353D turbocharged diesel engines with 375SHP/engine, twin screws - 5 blades each, diameter 48″, pitch 46″

Electrical system: 120/240v AC powered by 2 105KW diesel generators

B Class: 2 - Caterpillar D353D turbocharged diesel engines with 330SHP/engine, twin screws - 5 blades each, diameter 48″, pitch 46″

Electrical system: 120/240v AC powered by 2 45KW diesel generators

TRANSIT SPEED: Economical 6.0, Max 7.6-10.5, dependent on horsepower and tug/barge combination

TRANSIT ENVIRONMENT: Generally restricted to riverine environment. The 65′ WLR is marginally under powered. Transit of protected ICW possible when required, sea conditions should be strictly limited to less than 1 ft. due to barge interface system. The 65′ WLR gains its stability from the ATON barge it pushes, the WLR should not be moved when uncoupled except in emergency situations.

SERVICE ENVIRONMENT: Restricted to riverine environment, shallow water operation, the WLR has an installed spud mooring system. Sea conditions should be strictly limited to less than 1 ft. routine intentional groundings to service shore ATON. The western river system is dredged to a minimum 9 ft. channel depth.

ENDURANCE:

Ranges:	A Class	B Class
	1700 nm at 10.5kts	1700 nm at 10.5kts
	3500 nm at 6.0kts	3500 nm at 6.0kts

Capacities:

Fuel	1,017 gal.
Potable Water	2,872 gal.

Able to support the crew of 13 for approximately 15 days. Onboard stores of water and fuel are supplemented by barge-mounted storage tanks. Additional dry stores and freezer space also located on barge. Limited by sewage holding capability of approx 900 gallons.

Operation is generally limited to daylight hours (sunrise-sunset) day buoy ops, with occasional night transit steaming.

GENERAL DESCRIPTION: The 65′ WLR is similar in mission and design to the 75′ WLR, but has less power and poorer accommodations. The general description of the 75′ WLR applies, except that the 65′ WLR is not capable of working with the newer, larger 130′ river barge in open water due to their power and maneuvering limitations.

SMALL BOATS ASSIGNED: A mixture of FRs, WPs, and UTLs

SPECIAL CAPABILITIES: Equipped with headlog. The 65A Class WLRs push 130′ ATON Barges. The 65B Class WLR pushes 100′ ATON Barges.

SPECIAL LIMITATIONS: The 65′ WLRs cannot currently accept mixed-gender crews. They lack stability when not coupled to their barge and should not transit open water. 65′ WLRs have only steering rudders.

NUMBER OF CLASSES: 2

NUMBER OF EACH CLASS; TOTAL NUMBER: 2, 4; 6

130′ ATON Barge

LOA: 130 Ft. **BEAM:** 30 Ft. **DISPLACEMENT:** 400 Tons

DRAFT: @ full load displacement: 5 Ft.

MACHINERY PLANT: No propulsion machinery. Barge is equipped with a Cummins 6BT5.9 Engine to drive the installed air compressor and Fire/Jetting pump. Attached Appleton hydraulic crane is powered by a Cummins 4BT3.9 engine.

Capacity:

Fuel	-11,000 Gal. (to augment WLR)
Potable water	-8,000 Gal. (to augment WLR)

LIFT CAPACITY: Appleton hydraulic crane is currently Coast Guard rated at 2,000 lb. safe working load. This rating is currently in the process of being increased by G-ENE to 3,000 lb. safe working load.

HOOK HEIGHT AT DECK EDGE: 61′2″

CARGO CAPACITY: Deck Load 86,000 lb.

GENERAL DESCRIPTION: Eleven 130′ barges have replaced a variety of old barges.

100′ ATON Barge

LOA: 100′ **BEAM:** 30′ **DISPLACEMENT:** 139 Tons

DRAFT: @ 139 ton displacement; 3′8″

MACHINERY PLANT: No propulsion machinery. Barge is equipped with a GM 4-71 Engine to drive the installed air compressor and Fire/Jetting pump. Attached Allied hydraulic crane is powered by a Cummins 4BT3.9 engine.

Capacity:

Fuel	-14,900 gal. (to augment WLR)
Potable water	-9,568 gal. (to augment WLR)

LIFT CAPACITY: Allied hydraulic crane is currently Coast Guard rated at 2,000 lb. safe working load. This rating is currently in the process of being increased by G-ENE to 3,000 lb. safe working load.

HOOK HEIGHT AT DECK EDGE: 64′7″

CARGO CAPACITY: Not published (estimated, at 100 sinkers @ 1,000 lb./Sinker and 100 Class 6 buoys). Information provided by CGC SANGAMON (WLR 65606).

55' ANB

LOA: 58′0″ **BEAM:** 17′0″ **DISPLACEMENT:** 64,620 lbs

PROPULSION

2 - Diesel, GM 12V-71, 540 SHP/engine, twin screws, 3 blade propellers, 38″ diameter

LIFT CAPACITY:	A Class	B Class	C Class
13' reach stern notch	2000 lbs	3300 lbs	3300 lbs
13+ reach stern notch	1000 lbs	2000 lbs	2000 lbs
outside stern notch	1000 lbs	2000 lbs	2000 lbs

The A Class has the Husky M45 crane, B Class the Husky M60 and the C Class have a Coastal crane built to the Husky M60 specifications. The cranes are capable of extending 18′6″ and fully retracted are 13′.

HOOK HEIGHT AT DECK EDGE: 19 ft

CARGO CAPACITY: Deck Load: 4,000 Lb, Cargo hold: 4000 lb

TRANSIT SPEED: 21.5 Knot Maximum Speed

TRANSIT ENVIRONMENT: Protected cabin; max sea state not published, should not exceed ratings for 41′ UTB.

SERVICE ENVIRONMENT: Max 1-2 ft. for safe working.

ENDURANCE: Range 175 statute miles at maximum speed. Endurance is limited by fuel capacity. Boat is capable of supporting the crew for 4-5 days.

GENERAL DESCRIPTION: The boat is aluminum construction, of a V-bottom planing type fitted with twin diesel engines. There is a flush deck from approximately amidship aft, with an enclosed pilothouse forward, and a buoy notch at the transom. Galley and dinette are located in the pilot house, and in the forward part of the hull bunks and lockers are provided for four crew members along with a shower, lavatory, and water closet. Four transverse watertight bulkheads are provided. Any one compartment can be completely flooded and the vessel will stay afloat. Air conditioning and electric heating are provided in the pilot house, hull crew quarter, and the ATON workshop. A fire monitor is located forward on the main deck.

SPECIAL CAPABILITIES: Fuel Oil Capacity: 1,000 gal. Fresh Water Capacity: 240 gal. Sanitary Water Capacity: 220 gal.

SPECIAL LIMITATIONS: Limited berthing areas and crew support capability. No mixed-gender crew provisions. The 55 ANB was designed to operate in inland waterways, bays, sounds and harbors for routine and emergency service.

NUMBER OF EACH CLASS: A = 12, B = 7, C = 3, Total: 22

CLASS DIFFERENCES: Minor structural and equipment changes occurred over time and three different classes of the 55 ANB. The boats are all similar and are all capable of performing the same mission.

45′ BU

LOA: 45′3″ **BEAM:** 15′ **DISPLACEMENT:** 48,000 lbs

PROPULSION

1 - Diesel, GM 6-71, equipped with 150 SHP and "V" drive or 180 SHP and straight drive. Single screw, 3 blades, 30″ diameter, 26″ pitch

LIFT CAPACITY: 4,000 lb.

HOOK HEIGHT AT DECK EDGE: 12′4″

CARGO CAPACITY: 20,800 lb.

TRANSIT SPEED: 8.5 Knot Maximum Speed

TRANSIT ENVIRONMENT: Protected cabin; max sea state not published, should not be operated offshore due to open well forward.

SERVICE ENVIRONMENT: Max 1-2 ft. for safe working.

ENDURANCE: Range 550 nautical miles at maximum speed. Endurance is limited by habitability. Boat is designed primarily for "day trips" in inland waters, but is capable of supporting the crew for an occasional overnight. Galley and sanitary facilities are marginal at best.

GENERAL DESCRIPTION: The boat is steel construction, of a V-bottom type with a single diesel engine, coupled to a "V" drive or straight shaft. The 45 BU has an A-frame mounted forward with a cargo area forward of the deck house. A small generator provides AC power. Galley/dinette/berthing areas are located in the aft part of the hull. Minimum accommodations are provided for the four crew members, internal noise levels underway require single hearing protection in the galley/berthing area and double protection in the engine room.

SPECIAL CAPABILITIES: Fuel Oil Capacity: 550 gal. Fresh Water Capacity: 140 gal. Sanitary Water Capacity: None, self-contained portable toilet.

SPECIAL LIMITATIONS: Limited berthing areas and crew support capability, no mixed-gender provisions. High noise levels throughout. The 45 BU was designed to operate in inland waterways for routine and emergency service.

NUMBER OF CLASSES: Two: (Mark I and Mark II)

NUMBER OF EACH CLASS: Mark I = 10, Mark II = 6 Originally 16, approximately 10-12 remain in service.

CLASS DIFFERENCES: Minor structural and equipment changes occurred over time and production of the 45 BU. Hulls 45313 through 45317 are identical except they carry 480 gal. fuel and have a 180 HP 6-71 engine with a 2:1 reduction gear with a straight shaft. Range on these boats is 520 miles. The boats are all similar and are all capable of performing the same mission.

46′ BUSL

LOA: 46′4″ **BEAM:** 16′2″ **DISPLACEMENT:** 33,000 lbs

PROPULSION: 1 - Diesel, GM 6V-71, 180 SHP, single Schottel Rudder-propeller unit, Model SPR-100. Unit is PTO driven with no reverse gear, 360 degree steering is possible. Single 3 blade propeller, diameter 33″, pitch 29″

LIFT CAPACITY: 4,000 lb. using both whips; Single whip 2,000 lb.

HOOK HEIGHT AT DECK EDGE: 11′6″

CARGO CAPACITY: Deck Load, 16,000 Lb

TRANSIT SPEED: 9.5 Knot Maximum Speed

TRANSIT ENVIRONMENT: Protected cabin; max sea state not published, should not exceed ratings for 41′ UTB.

SERVICE ENVIRONMENT: Max 1-2 ft. for safe working.

ENDURANCE: Range 130 nautical miles at maximum speed. Endurance is limited by fuel capacity. Boat is capable of supporting the crew for 48 hours.

GENERAL DESCRIPTION: The boat is steel construction, of a V-bottom type fitted with a rudder-propeller unit coupled to a single diesel engine. The 46 BUSL has a fiberglass surfaced plywood cabin forward, and a buoy notch at the transom. A hydraulically operated A-frame is located aft on the main deck and used for ATON work. Galley and dinette are located in the forward part of the hull, bunks and lockers are provided for four crew members along with a shower, lavatory, and portable toilet. Air conditioning and electric heating are provided in the pilot house and hull crew quarters.

SPECIAL CAPABILITIES: Fuel Oil Capacity: 180 gal. Fresh Water Capacity: 80 gal. Sanitary Water Capacity: None, self-contained portable toilet.

SPECIAL LIMITATIONS: Limited berthing areas and crew support capability, no mixed gender provisions.

NUMBER OF CLASSES: Two (A and B)

NUMBER OF EACH CLASS: A = 6, B = 9

CLASS DIFFERENCES: B class vessels are equipped with 400 gallon capacity, and increased range to 250 nautical miles. The boats are similar and are all capable of performing the same mission.

TANB - Trailerable Aids To Navigation Boat

The 21 TANB is currently being purchased by the Coast Guard under contract from SeaArk Corporation, Monticello, AR.

LOA: 21′4″ **BEAM:** 8′0″ **DISPLACEMENT:** 3,500 lbs

DRAFT: 1′2″

LOAD CAPACITY: 3,500 lbs (including crew and fuel)

PROPULSION:

Currently two "standard configurations" of TANB propulsion equipment exist, these are:

1. Mercriuser V-8 Gasoline (350 GM Engine) 175/200 HP range.
2. Volvo Diesel (AQAD-41 Series Engine) 185/200 HP range.

Alternate configurations found are:

1. OMC Cobra V-8 Gasoline (302 Ford Engine) 188/200 HP range.

PROTOTYPES

A Sebron Tunnel Drive propulsion system is currently being prototyped on the 21 TANB installation should be complete for an August 1993 evaluation.

A prototype package is being compiled to test a Mercruiser diesel stern drive to replace the Volvo currently in service. The D4.2 L220 Series Mercruiser is currently listed on SeaArks GSA schedule as an option for the TANB.

LIFT CAPACITY: 250 Lb (with optional davit).

CARGO CAPACITY: Total load not to exceed 3,500 Lb.

TRANSIT SPEED: 20 knot+ (varies with load).

TRANSIT ENVIRONMENT: Open cockpit area, max sea state not published, should not exceed 3 ft.

SERVICE (WORK) ENVIRONMENT: Max 1-2 ft. for safe working.

ENDURANCE: Range varies with propulsion and available fuel tank configuration. Endurance is limited by fuel capacity. SeaArk offers varying combinations of side mounted "saddle" and center mounted "belly" tanks. Diesel powered units have a greater range than gasoline powered units.

GENERAL DESCRIPTION: The boat is aluminum construction, of a V-bottom type fitted with a single gasoline or diesel inboard/outboard unit. The TANB is of open cockpit construction and can be fitted with a 250 lb. capacity davit depending on operational requirements. The TANB is designed to be trailerable and available for light ATON work and emergency response. Normal compliment is 2-3 crew members.

SPECIAL CAPABILITIES: Fuel Oil Capacity: 36/86 gal. Fresh Water Capacity: -0- Sanitary Water Capacity: -0-

SPECIAL LIMITATIONS: The 21 TANB was designed as a fast response platform to service minor aids to navigation and to correct ATON outages. The boats were designed to be trailerable and to operate in inland waterways, bays, sounds and harbors for routine and emergency service.

NUMBER OF CLASS: 89

CLASS DIFFERENCES: Minor structural and equipment changes occurred over time and numerous different production runs of the 21 TANB. The boats are all similar and are all capable of performing the same mission.

Non-standard Work Punt (WP)

LOA: 16′ to 20′

CREW: 3 ENL

DRAFT: 8″

MACHINERY PLANT: Single or twin outboard 25 or 35 Hp.

LIFT CAPACITY: None.

CARGO CAPACITY: Varies, 1080 to 3700 lbs.

TRANSIT SPEED: Max 18 kts

TRANSIT ENVIRONMENT: Rivers and inland waterways.

SERVICE ENVIRONMENT: Rivers and inland waterways.

ENDURANCE: Varies, limited by fuel capacity 6 gallons portable to 30 gallons installed.

GENERAL DESCRIPTION: Work punts in various configurations are used to transport personnel and supplies to service fixed ATON, recover beached buoys (in rivers), assist in flood relief efforts, and other general small boat missions. Work punts are carried on board small cutters in protected waters, and used by shore units. They are small, commercially available open boats.

NUMBER OF CLASSES: No specific class designations, boats from multiple buys are in service.

NUMBER OF EACH CLASS: Approximate total: 20

CLASS DIFFERENCES: Minor structural and equipment changes occurred over time and multiple purchases. The boats are all similar and are all capable of performing the same mission.

MCB - Motor Cargo Boat

LOA: 25'8" **BEAM:** 7'11" **WEIGHT:** (hoisting weight): 5070 lbs

DRAFT: 2'2"

PROPULSION: 1 - GM 3-53 direct drive diesel, 80 SHP, single 3 blade propeller, 18" diameter, 13" pitch

LIFT CAPACITY: This class boat does not have any lifting capabilities.

CARGO CAPACITY: 2000 lbs.

TRANSIT SPEED: 12 knots (varies with load).

TRANSIT ENVIRONMENT: Open cockpit area, max sea state not published, but the boat is similar to the MSB whose characteristics are described as light to moderate seas.

SERVICE (WORK) ENVIRONMENT: For approaching buoys or unprotected structures, 1-2 ft seas max.

ENDURANCE: Fuel: 40 gals., 85 miles. Endurance is limited by fuel capacity.

GENERAL DESCRIPTION: The boat is fiberglass construction, of a round bottom type fitted with a single diesel inboard direct drive unit. The MCB is of open cockpit construction, and is non-self bailing. It is only assigned to WLBs and is carried on board the cutter.

SPECIAL LIMITATIONS: Fresh Water Capacity: -0- Sanitary Water Capacity: -0-

NUMBER OF CLASSES: No specific class designations exist.

NUMBER OF EACH CLASS: Total: 21 (currently as of 8/5/93, 17 are assigned aboard WLBs)

CLASS DIFFERENCES: None.

MSB - Motor Surf Boat

LOA: 25′8″ **BEAM:** 7′1″ **WEIGHT:** (hoisting weight): 5070 lbs

DRAFT: 2′1″ (full load) 1′10″ (op load)

PROPULSION: 1 - GM 3-53 direct drive diesel, 80 SHP, single 3 blade propeller, 18″ diameter, 15″ pitch

LIFT CAPACITY: This class boat does not have any lifting capabilities.

CARGO CAPACITY: 2430

TRANSIT SPEED: 9 knot (varies with load).

TRANSIT ENVIRONMENT: Open cockpit area, max sea state not published, but the general description limits the boat to moderate seas.

SERVICE (WORK) ENVIRONMENT: For approaching buoys or unprotected structures, 1-2 ft seas max.

ENDURANCE: Fuel Oil Capacity: 30 gals., 60 miles. Endurance is limited by fuel capacity.

GENERAL DESCRIPTION: The boat is fiberglass construction, of a round bottom type fitted with a single diesel inboard direct drive unit. The MCB is of open cockpit construction, and is non-self bailing. Currently only one is assigned to the WLB fleet (IRIS).

SPECIAL LIMITATIONS: Fresh Water Capacity: -0- Sanitary Water Capacity: -0- limitations.

NUMBER OF CLASSES: No specific class designations exist.

NUMBER OF EACH CLASS: Total: 21 (Currently as of 8/5/93, 17 are assigned aboard WLBs)

CLASS DIFFERENCES: None.

RHIB/RHIM - Rigid Hull Inflatable

LOA: 21'6"/19'11" **BEAM:** 8'0"/7'8" **HOISTING WEIGHT:** 3400/2165 lbs

DRAFT: 33"/28"

MACHINERY PLANT

Type 1 - VOLVO inboard/outdrive/diesel, Type 2 - OMC outboards/gasoline

LIFT CAPACITY: This class boat does not have any lifting capabilities.

CARGO CAPACITY: (including crew and fuel) 2240 lbs/2610 lbs

TRANSIT SPEED: diesel 32 kts outboards 35 kts

TRANSIT ENVIRONMENT: Open cockpit area, Max sea state not published, but the general description limits the boat to light to moderate seas.

SERVICE ENVIRONMENT: For approaching buoys or unprotected structures, 1-2 ft seas max.

ENDURANCE: Fuel: 34 gals diesel/24 gals gasoline. Endurance is limited by fuel capacity.

GENERAL DESCRIPTION: The boat is fiberglass hull with neoprene inflatable tubes, of a semi-V bottom type fitted with a single diesel inboard/outdrive or twin gasoline outboards engines. The RHIB/RHIM is of open cockpit construction, and is self bailing. They are assigned to buoy tenders and are carried on board the cutter. Currently, the outboard gasoline-powered boats are being replaced with the inboard/outdrive diesel powered which is a slightly larger boat. The boats are hoisted and lowered by means of the single-point davit system on the WLBs and by various davit systems in the remainder of the fleet.

SPECIAL CAPABILITIES: This type of small boat is well suited for approaching other vessels and ATON (both floating and fixed) with reduced risk of damage due to the inflatable tubes on the boat.

SPECIAL LIMITATIONS: These boats have no hoisting capabilities.

NUMBER OF CLASSES: No specific class designations exist.

NUMBER OF EACH CLASS: This is a CG wide boat. For numbers authorized see the cutter class.

CLASS DIFFERENCES: None.

GLOSSARY

-A-

Acetylene Cylinder - A portable bottle-shaped steel cylinder used to store acetylene gas under pressure.

Adrift - A floating aid broken loose from its mooring and drifting off station.

Advance - The net distance a vessel travels in its original course from the time the rudder is put over until it's steadied on the new course.

Aids to Navigation (AtoN) - Any device external to a vessel or aircraft intended to assist a navigator to determine his position or safe course, or to warn him of dangers or obstructions to navigation.

ANB (Aids to Navigation Boat) - 55-foot boats attached to ANTs, fitted with hoisting equipment, whose function is to service aids to navigation, usually in a relatively limited area. Works Aids to Navigation astern. Capable of offshore work for quick discrepancy response.

Anchor hawk - A heavy (normally four-bladed) grapple used to drag for sunken buoys. See Grapple.

ANT (Aids to Navigation Team) - Shore based team of between 4 to 25 persons of various ratings that are responsible for scheduled maintenance of all assigned major and minor aids to navigation. Also provides rapid response to discrepancies of own assigned as well as other units' aids. Assigned a variety of boats and equipment to accomplish mission.

Avast - Order to stop or cease.

-B-

Backfire - Gases in the tip of a torch that explode back to the point of gas mixing in the torch. A sustained backfire occurs when the flame burns back inside the torch at the mixing point, making a hissing sound and a thin, small flame at the tip.

Bail (Bale) - A metal lifting eye secured to an object.

Barrel sling - A two-legged sling fitted with hooks designed to attach to the chine of a barrel.

Battery box - A box placed on the bell stand of a buoy (watertight) or mounted onto a structure (water resistant), which contains the batteries for the aid.

Battery rack - A metal container for holding batteries, which is inserted in the pocket of a lighted buoy.

Beacon - An obsolete term, formerly referring to a shore aid to navigation. The term is still being used by maritime interests outside the Coast Guard.

Belay - To take one or more "S" turns with a line around a cleat or belaying pin without tying it in a knot. Also, to cancel an order.

Bight - A loop of line, or chain.

Bitts - A pair of short steel posts or horns aboard a ship used to secure lines.

Bitter end - The absolute end of a piece of line or cable.

Block - A device made of a wheel (sheave), inside a shell, over which a line or wire rope can run freely.

Block and Block - See Two-Blocked.

Boat hook - Wooden staff with combined hook and pushing surface mounted on one end, used to fend off, hold on, or retrieve.

Bollard - Strong cylindrical upright on a pier, around which the eye or bight of a ship's mooring line is thrown.

Boom - A long spar projecting from a mast, a base or the base of an A-frame, used to support lifting tackles; a derrick arm; a crane.

Bow thruster - A small propeller set in a tunnel in the bow (or at the end of a post under the hull), which pushes the bow to port or starboard.

Bridle - Two short lengths of chain connected by an iron ring; used in connecting mooring chain to lighted and some unlighted buoys or for lifting heavy weights.

Brushing - The elimination of vegetation surrounding (obscuring) an aid by using machetes, chainsaws and herbicides.

BU (Buoy boat) - A bow-loading 45 foot boat fitted with hoisting equipment, generally assigned to an ANT, whose function is to service aids to navigation, usually within a relatively sheltered area.

Bull chain - Large chain run fore-and-aft between two padeyes inboard of the buoy port on the side where the buoy is brought aboard.

Bull line - See Cross-Deck line.

Bulwark - Solid fence-like barrier along the edges of the weather deck.

Buoy - A floating object moored to the bottom to indicate a position on the water or to moor a vessel.

Buoy appendages - Mooring equipment for a buoy; chain, sinker, bridle, shackles, ballast ball, etc.

Buoy body (hull) - The enclosed portion of a buoy, i.e., the portion that provides the flotation.

Buoy cage (tower) - The skeleton metal framework mounted on the buoy body to support the lantern and other equipment attached to the buoy.

Buoy chain (open link) - A series of elongated metal rings joined to form a means of mooring a buoy. May be steel or wrought iron.

Buoy chock - See Head block.

Buoy cradle - See Saddle.

Buoy lifting eye - Bail at the top (also the side of unlighted buoys) of the buoy body for lifting.

Buoy mooring eye - Bail on the bottom of the buoy hull to which the mooring or bridle and mooring is attached.

Buoy pocket - A cylindrical confined interior section of a buoy body containing a battery rack. Pockets are fitted with watertight covers.

Buoy port - An open section of the bulwarks on each side of the working deck of a tender, through which buoy, appendages, etc., are launched and recovered.

Buoy station - The established location of a buoy.

Buoy tender - A vessel designed for, and engaged in, servicing aids to navigation, particularly buoys.

Buoy tube - A long counterweighted metal cylinder attached to the bottom of the buoy.

Buoy vent - A metal tubing, connected to the pocket, fitted with a ball check valve, which allows air to enter and explosive gases to vent from the buoy pocket, but prevents water from entering the pockets.

Buoy, unlighted - See Unlighted buoy.

BUSL (Buoy Boat, Stern Loading) - A 46- and 49-foot boat that is stern-loading, fitted with hoisting equipment, generally assigned to an ANT, whose function is to service aids to navigation, usually within a relatively sheltered area.

-C-

Cage - See Buoy cage

Cage line - A line rove through the cage of a buoy to steady it while alongside or being hoisted.

Can buoy - An unlighted buoy having a cylindrical portion showing above the water line.

Capstan - That part of a vertical shaft windlass around which a working line is passed; used for heaving in anchors and hawsers.

Cargo Boom - See Boom.

Cargo net - A square net of varying sizes made of Manila, wire rope, nylon straps or chain, and used for slinging case goods or small package freight. Also may be slung between a vessel and the pier or another vessel during loading operations as a safety net.

Cast - The act of heaving a lead into the water to ascertain water depth. Also to move a vessel's bow or stern to port or starboard when getting underway by use of the rudder, spring lines or kedging anchors.

Cat's Pawl - See Pawl.

CCA - See Chromated Copper Arsenate.

Chafe - That section of the buoy mooring chain that is constantly rubbing on the bottom as the buoy rises and falls in the seas.

Chaffing gear - Additional material placed over sections of line that are prone to wear.

Chain hook - A handled metal hook about 32 inches long used to manually haul bights of chain about the deck.

Chain sling - A short variable length of high tensile strength chain having an elongated pear-shaped link or hook in each end. It is used to hoist heavy weights on board tenders.

Chain Stopper - A mechanical jaw device for securing or stopping of mooring chain to the deck.

Characteristic - The color and shape of a daymark or buoy or the color and period of a light used for identifying the aid; the identifying signal transmitted by a radiobeacon.

Charging a buoy - Installing and connecting batteries in a lighted aid to navigation.

Check - To slack off slowly, generally used to prevent a line from parting.

Check angles - Horizontal sextant angles measured at a buoy station other than those used to locate the buoy. These serve to check the position.

Chinese stopper - A two-legged stopper that is wrapped in alternating directions.

Chocks (Open, Closed, Rolling) - A metal casting which serves as a lead for lines.

Chromated Copper Arsenate (CCA) - A light green liquid chemical compound used to pressure treat wooden piles, timbers and lumber. CCA is poisonous to marine life (i.e., terodes) and is replacing creosote as the treatment of choice. Also referred to as "salt treatment" due to arsenate salt compounds used. See Creosote.

Cleat - A metal casting with two projecting horns to which lines are belayed.

Clevis hook - Consists of two opposed hooks on the end fitting, which close upon each other.

Closed - Discontinuance of an aid on a fixed structure for the winter season.

Come-along - A mechanical ratcheting device used to tighten straps.

Commissioned - An aid previously reported "closed" or "withdrawn" has been placed in operation.

Counterweight - A heavy weight, usually metal, fastened to a lower portion of a buoy to increase its stability.

Cradle - See Saddle.

Creosote - A dark brown to black oily liquid preservative used in the preservative treatment of wooden piles, timbers and lumber. Creosote is poisonous to marine life (e.g., toredoes) and helps prevent rot and decay. It is also carcinogenic. The use of creosote is slowly disappearing with the use of CCA preservative. See CCA.

Cross-deck line - A heavy line having a hook or eye in one end, which is led from the windlass or capstan through snatch blocks on deck to a large buoy or other weight for steadying purposes.

Cross-over tube - A small tube that runs between the battery pockets within the buoy. This tube allows free passage of air in one vent into the pocket, through the cross-over tube to the other pocket and out the other vent.

-D-

Daybeacon - An unlighted structure which serves as a daytime aid to navigation by virtue of its distinctive appearance which makes it recognizable and identifiable.

Daylight control - A photoelectric cell that senses the amount of sunlight. It activates an on-off switch in the flasher which turns the light on at dark and off during the daylight hours.

Daymark - The daytime identifying characteristics of an aid to navigation. The daymark qualities of an aid are unique and distinctive to facilitate its recognition. Also a conspicuous target added to a daybeacon or light. The Second Coast Guard District refers to daybeacons as daymarks.

Dead In the Water (DIW) - An object or vessel that is not moving.

Deck load - A general term for all that is laden aboard a vessel for work.

Derrick - See Boom.

Discontinue - Authorized removal from operation. Aid to be deleted from the published Light List.

Disestablishment - The act of permanently removing from service a previously authorized, permanent aid to navigation.

DIW - See Dead In the Water.

Dogs - A colloquial term applied to buoy pocket cover hold-down swing bolts.

Dolphin - See Pile Dolphin.

Dredge - To drag an anchor at short stay over the bottom as a steadying influence over the ship.

Driven to refusal - See Refusal.

Drum - The cylindrical part of a capstan, which the line is wound around. Also called the Barrel.

Dunnage - Lumber, or other material, used to protect cargo in the hold of a ship; planks placed on deck to add friction between flat surfaces and the deck.

-E-

Ease - To reduce the amount of helm by a certain amount, or in the absence of an amount, halve it. Also, to slacken a line gently when taut.

End fitting - Various fittings designed to be attached to wire rope.

End for end - To reverse something, generally chain to facilitate even wear.

Extinguished - Lighted aid not lit.

-F-

Fairlead - A simple pulley or eye through which line is run to change its direction, no mechanical advantage is gained. A snatch block often serves as a fairlead.

Fake - A term commonly and incorrectly used on tenders to mean the lying out of bights of chain on deck for running freely over the side. The correct name for this practice is "ranging".

Fender - Term applied to various devices, fixed and portable, serving to cushion the shocks and protect the shell plating when a vessel comes into contact with a pier, or the like, or another vessel.

Fiege fitting - A three-piece wire rope end-fitting consisting of a sleeve, a plug and a covering socket. The plug is inserted into the core, holding the strands against the sleeve and the socket goes on top.

Fishhook - A broken end of wire protruding from a wire rope.

Fix - The establishment of a position on the water by means of angles, bearings or electronic equipment.

Fixity - A term used to describe when a pile (wood, concrete or steel) has been driven to the depth that the surrounding soil will provide the required load bearing support of both the pile and its intended load.

Flashback - An explosion, while using a torch, which takes place between the mixing chamber and the gas cylinders.

Flasher - An electrically powered device which produces light flashes of a prescribed characteristic in an electric lantern.

Foul - When an object (generally anchor or chain) is entangled with some foreign substance (line, mud).

Foundry hook - Hooks designed to fit a specific size chain link.

-G-

Gang bridle - Multiple-legged bridle.

Grapnel hook - A multipronged anchor of various weights used for dragging the bottom to recover sunken objects.

Gripe - To secure firmly.

Gun tackle - A tackle composed of a fall and two single blocks.

Gypsy head - The drum on the end of a windlass shaft used for hauling rope.

Guy - See Vang.

-H-

Hand-over-hand - The act of hauling rapidly upon a rope by personnel passing their hands alternately one before the other.

Happy hooker - A mechanical reeving device placed at the end of a wooden shaft. Used to "hook" the tenders main or whip into a buoy bale.

Hatch - An opening, generally rectangular, in a ship's deck affording access into the compartment below.

Hatch cover - A wooden or metal cover or shutter fitted over a hatch to prevent the ingress of water into the ship's hold.

Hawser - A heavy line more than 5 inches in circumference used for towing or mooring.

Head block - A wooden square cross section block used to secure a buoy, often used in conjunction with a buoy cradle.

Head line - See Cage line.

Heat and Beat - See Rivet-pin shackle.

Heave around - To cause the drum of a capstan or windlass to revolve, thus hauling in the anchor chain (on the wildcat) or line around the drum.

Hitch - Method of securing a line to hook, ring, or spar.

Hogging chain - A shot of buoy mooring chain dipped under the tender and secured on deck at either side. Used for transferring a mooring from one side of the ship to the other when relieving buoys on West Coast bars.

Hogging line - A heavy line having a hook in one end and led from the windlass or capstan to the mooring chain to haul it forward and into the chain stopper.

Hoist - To raise or lift, especially by means of a line, block, or tackle.

Horse collar - A semi-circular piece of metal attached to the outboard side of the chain stopper, which prevents the chain from leading too far outboard.

Hot pack - Small, portable system of batteries that are installed as a temporary source of power when the regular system has failed.

-I-

Inboard - Toward the fore-and-aft centerline of the ship. Inside the deck edge or shell plating, as opposed to outboard.

-J-

Jet cones - Small open-topped conical steel pieces attached to wire rope, used for moorings in river environments. These cones are washed into the bottom (See Jetting) with high pressure hoses.

Jetting - The use of high pressure water, at times with air induced, piped alongside a pile to aid driving it.

Jetty - A breakwater built to protect a river mouth or harbor entrance or to direct the flow of current.

Jigger - See Luff tackle.

-K-

Kedging - Moving a ship by means of small anchors and hawsers.

Keel haul - To drag a buoy or other object under the keel from one side of the vessel to the other.

Key hammer - A light hammer having a straight peen on the head opposite the hammer face. It is used for flaring out or driving out split keys in the buoy mooring shackles.

Kingpost - Post supporting the cargo booms on ships. Also the upright that supports the boom of some cranes.

Kink - A twist which disturbs the lay of line and wire.

Krane Kar - A vehicular crane used ashore to lift weights, including buoys.

-L-

Lamp - Common term used for the electrical "light bulb" which provides illumination for an aid to navigation. Lamps are most often used in conjunction with lamp changers.

Lamp changer - A device for shifting lamps once the main one is extinguished.

Lay - The direction of the twist of strands of rope. Also to direct members of the crew to go to certain places (e.g., lay to the messdeck).

Lay length - The distance it takes one strand to go completely around the rope.

Leadline - A weighted line with identifying markers attached (e.g., rags, leather) to help in determining the water depth. Example: the marker for ten fathoms is a piece of leather with a hole in it. The leadline can also be used to determine the type of bottom by the addition of tallow, soap, etc., in the cavity in the bottom of the lead (this is called "arming the lead").

Lifeline - A cable which is run through eyelets on the top of stanchions on the weatherdecks of ships.

Line - A nautical term for rope.

Live chain - Chain with the potential to run over the side.

LNB (Large Navigational Buoy) - A 12-meter buoy designed to replace lightships marking the approaches to waterways.

Load binder - A tensioning device consisting of two hooks connected by chain, at the center of which is an angled piece of metal which when closed up and secured against one of the lengths of chain, increases the tension.

Local Notice to Mariners - A locally disseminated issue of Notice to Mariners affecting a specific area.

Luff tackle - Purchase containing one single and one double block (single luff or jigger) or a double and triple block arrangement (double luff).

-M-

Main (tackle, purchase) - A multiple hoisting purchase used on board tenders to hoist heavy weights. It is usually the most powerful tackle of the hoisting tackles.

Marker buoy - A small brightly painted moored float used to temporarily mark a location on the water while placing a buoy on station.

Marlinspike - A pointed steel tool used by riggers and seaman to separate the strands of rope when splicing and also as a lever when putting on seizings, marling, etc.

Marry - To join together, such as two ropes joined in a seizing.

Mechanical advantage - Using a system of blocks or gears to obtain higher output force than input force.

Messenger - A general term for lines sent out to lead heavier ropes, such as to lead a towing line to a disabled vessel.

Modeer shackle - A special type of 1- and 2-inch U shackle equipped with locking bar-type pin, widely used on West Coast tenders for hoisting and stopping off mooring chain.

Mooring - The chain connecting a buoy to a sinker. Sometimes used to include the sinker as well. Its purpose is to maintain the buoy or other floating object in a specific location.

Mousing - A seizing of light line or wire across a hook, which prevents a sling from slipping off and which strengthens the hook. Also, seizing which prevents screw pin of shackle from unthreading.

MSDS (Material Safety Data Sheet) - A federally required form with all chemicals. It describes the make-up of the compound, whether it is hazardous, antidotes, etc. It is required to be maintained in the same location as the chemical, as well as in a separate file.

-N-

Nipper chain - A section of chain with rings on both ends. Used by passing one ring through the other and cinching up on a mooring chain or load.

Notice to Mariners - Public announcements either by broadcast or printed notices disseminating marine information to the public, including items of establishment, change, or discontinuance of aids to navigation, as well as other items regarding obstructions, changes in channel conditions, etc.

Nub - Small portion of a wooden, metal or concrete pile sticking out from a surface.

Nun buoy - An unlighted buoy having a conical portion showing above the water line.

-O-

Off station - A floating aid that has been moved from its station by adverse conditions; a discrepancy to be corrected.

Outage - The failure of an aid to navigation to function exactly as described in the Light List.

Outboard - Outside of a vessel's hull. Away from the center or keel line. The opposite of inboard.

Overriding turns - Turns placed over existing turns on a capstan or winch.

Oxy-Acetylene torch - A torch producing an intense flame utilizing acetylene gas as its fuel. Used to cut chain and other metal. Can be used to heat metals to a "cherry red" condition so they can easily be bent or worked.

-P-

Padeye - A steel eye, often with a link attached, welded to a deck plate to provide a secure object to attach things to.

Pallet - A portable platform used in handling cargo on fork-lift trucks or slings. Palletized cargo is made up to fit the pallets.

Pawl - A short piece of steel hinged at one end to the pawl head of a capstan. It drops by gravity into the chain links to prevent any backward motion when power was removed.

Pear link - An oblong metal link on the end of a short chain or wire strap. Can be used for numerous purposes such as attachment of hooks, shackles, etc.

Pelican hook - A hinged hook consisting of a strongback and tongue, fitted with a hinged link for tripping while under strain.

Pendant - A length of wire rope with an eye spliced in one end and a hook in the other. Used for hooking on and picking up buoys and other weights. Sometimes called a picking pendant.

Picking Pendant - See Pendant.

Pigtail - A short length of chain left over after the mooring is connected to the sinker. This is used to pick up the sinker and hang it over the side.

Pile - Wooden or steel post set into the water to create a structure.

Pile dolphin - A minor light structure consisting of a number of piles driven into the bottom in a circular pattern and drawn together at the top. Referred to in the Light List as Dolphin.

Plumb (a hatch) - To rig a tackle directly over it.

Preventer - Any line, wire or chain whose general purpose is to act as a safeguard in case something else carries away.

Primary cell - A type of battery which cannot be recharged.

Punt - Rectangular shallow boat used on many smaller tenders and during flood relief operations.

Purchase - A combination of one or more blocks reeved with a line or wire. See Tackle.

-R-

Rack - The athwartships or sidewise movement of a boom or derrick.

Radar Reflector - Flat pieces of radar reflective material placed on or built into an object to make it more radar reflective than it would be ordinarily. Certain unlighted and most all lighted aids have these.

Radiobeacon - Electronic apparatus which transmits a radio signal for use in locating a mariner's position.

Ratchet binder - See Steamboat jack.

Recharged - Replacing the batteries in an aid.

Recovered - An aid previously reported adrift or missing has been retrieved.

Reeve - To run a line through an eye.

Reeving line - This line is reeved through a bail on the buoy prior to hooking it. It is attached to the mouth of the hook and with a tripping line is used to guide the hook in.

Refusal - When a pile has been driven to the point where it will penetrate no further, and more blows will damage either the pile or the pile-driving equipment.

Retroreflective tape - Tape that is specially constructed to reflect light back to the source from more than one angle. Used for the numbers and border on buoys and daymarks.

Rigging - The ropes, lines, wires, turnbuckles, and other gear supporting topside structures. Standing rigging is more or less permanently fixed. Running rigging is adjustable, e.g., cargo handling gear.

Relieved - Replacement of an aid with an aid of the same type and characteristic.

Relighted - A lighted aid, previously reported extinguished has been relighted.

Relocated - Authorized movement from one location to another in the immediate vicinity with no alterations. Published Light List description and chart to be changed accordingly.

Reset - A floating aid previously reported off station, adrift or missing has been returned to its station.

Rivet-pin shackle - A connecting shackle used in buoy moorings where the chain is subjected to wear such as in the chafe. The pin is heated and peened over, commonly known as a "heat and beat."

Rock - See Sinker.

Roller chocks - A chock fitted with vertical rollers in order to minimize friction on lines passing through.

Rotten stop - A light lashing intended to part under a strain; serves as a brake to check the speed and violence of chain running off the deck.

-S-

Saddle - Two wooden blocks connected by metal bars that are cut to fit the contour of the buoy hull, used for steadying and securing buoys on deck and ashore.

Safe Working Load (SWL) - The maximum load, expressed in pounds, that the ship's weight handling gear (e.g., cargo handling, boat davits, aids to navigation booms, etc.) can safely lift or pull without risk of failure by the rigging or associated equipment.

Safety chain - Chain run the length of an opening in the bulwark or rail.

Safety shackle - A shackle with one end of the pin having threads, and a nut is secured after passing through the shackle; there is also a hole through the threaded end for a cotter pin to stop the nut from backing off.

Screw pin shackle - A shackle where one of the openings is threaded to accept a threaded tip pin.

Secure - To cease or stop doing something. Also to fix in place.

Seizing - The lashing of two parts of line by continuous turns of small stuff.

Set - The direction a vessel is moving away from its intended track.

Setting a buoy - The act of placing a buoy on station in the water.

Sheave - The wheel in a block; a pulley.

"Shoot the tube" - The counterweights and tubes on large lighted buoys are open (to allow air to move to power a whistle); often small mussels and other "buoy critters" attach themselves inside. A person shoots the tube when he/she climbs inside and scrapes all this material out.

Shot - A unit of measurement of chain equal to 15 fathoms (90 ft.).

Side-load (the boom) - Placing the load in such a location that a horizontal force vector is enacted upon the boom.

Sinker - A heavy concrete or cast iron buoy weight, which is attached to the lower end of the mooring chain in order to anchor the buoy in its charted position.

Skeleton tower - A tower, usually of steel, constructed of heavy corner members and various horizontal and diagonal bracing members.

Slack off - To pay out line without losing control of it.

Sling - A rope, wire, synthetic fiber, or chain used to hold an object securely for hoisting.

Slushing - The application of a protective coating on a wire rope.

Small stuff - General name given to all the small lines or ropes under one inch in circumference used on board ship.

Snaking - A term used to describe the horizontal moving of heavy piles, timbers or other items on deck with the use of winches, capstans or booms.

Snap hook - A metal hook closed by a spring snap.

Snatch block - A single-sheaved block with a hinged strap which can be opened and the bight of a rope inserted, making it unnecessary to reave the end of the rope through the block.

Solar panel - A panel of photovoltaic cells that generally comes in 10-watt, 20-watt and 35-watt sizes. These panels are used to convert sunlight to electricity to recharge a lighted aid's batteries during sunlight hours.

Soundings - Water depth readings.

Spelter socket - A closed socket (end fitting) attached to wire rope by pouring hot zinc.

Split-key shackle - A widely used shackle for connecting chain to buoys and sinkers. It has a long slotted pin and a split leaf-type key.

Spot (boom) - To pre-position the boom so that the object being lifted will either remain directly below the boom tip, or move in that direction.

Spuds - Long vertical metal, or metal-framed wooden timbers, that are hoisted and lowered in through "spud wells" on inland tenders to hold the vessel firmly in place. Used primarily to hold the vessel when building marine structures.

Stand by - The order to wait at the ready.

Station - The authorized location of an aid.

Steamboat jacks - A turnbuckle fitted with handle and tongue to ratchet and utilize leverage to quickly attain more tension. Fitted with hooks on either end to bring two ends closer together. Also ratchet binder. There are pneumatic versions which use pressurized air to tighten.

Steerageway - The minimum amount of vessel speed required to maintain a course or respond to rudder commands.

Stow - To put anything away for sea. To put gear in its proper place.

Strain - To place a line under high tension.

Strikedown - Take material below decks for storage.

Surge - To allow a line to slip.

Sustained backfire - See Backfire.

Swing arms - Found on 7x17, 5x11 and 3x8 (flat-bottom) buoys, these attach to the sides of buoy hull and extend downward; the bridle attaches to these. This prevents the bridle from rubbing the counterweight and allows the buoy to be moored in relatively shallow areas.

Swingbolt - See Dogs.

Swivel - A pair of adjoining links, one of which may turn independently of the other; an appendage used in buoy moorings.

-T-

Tackle - An assembly of blocks and rope (wire or fiber) for obtaining a mechanical advantage for hoisting weights.

Tag line - A line used to steady a load being swung in or out.

TANB - 21-foot Trailerable Aid to Navigation Boat capable of discrepancy response for smaller lighted buoys and most structures.

Teeter board - A small metal or wooden board used to dump the smaller sinkers (up to 500 pounds) by placing the sinker on one end and using it as a fulcrum.

Tension - A minimum amount of strain placed on a line or wire to remove all slack.

Topping lift - A heavy multiple tackle supporting the weight of the boom and the object being hoisted. It controls the angle of elevation of the boom.

Transfer - The net distance a vessel travels laterally from the time the rudder is put over until it's steadied on the new course, measured as a perpendicular to the original course.

Tripping line - A line secured to an eye on the back of a lifting hook for controlling and clearing it from the object being hoisted or lowered.

Tube gripe - A less strong gripe consisting of the hogging line made fast to the tube of a buoy.

Twisting - When a twin-screw ship goes ahead on one screw and astern on another, causing the bow to swing to the side the backing screw is on.

Two-block - When a tackle has reached the limit of its hoist and the upper and lower blocks meet each other. The tackle must then be lowered or overhauled. Also Chock-a-block.

-U-

Unlay - To untwist and separate a rope's strands.

Up and down - When the chain running over the side from a vessel is straight up and down, neither forward nor aft and neither inboard or outboard.

Up behind - The command to take all strain off the line; completely slack it and drop it.

-V-

V-band - A battery pocket closure system utilizing a circular stainless steel clamp to compress a cork gasket between a grooved cover and pocket flange. It is no longer authorized for use by itself, and must be accompanied by a swingbolt closure system.

Vangs - A tackle leading from each side of the boom to attachment points on the port and starboard side of the ship. Used to move the boom either to port or starboard (and in some cases up and down) and provide some stability to the boom. Vangs can be powered either manually or mechanically.

Vent valves - A specialized version of a check valve, they are designed to seal the vent lines on lighted buoys if the aid heels over more than 30 degrees or submerges.

-W-

Weather hitch - A knot used to secure a line after belaying. A bight is twisted on top of itself and cinched down.

Whelp - One of the projecting ribs fitted on the periphery of a capstan barrel or gypsy head to give better grip to the line. Also, one of the sprockets on the wildcats of a windlass which engage the links of the chain cable.

Whip - A single hoisting wire rope led from the boom and having a hook on the end for hoisting weights.

Winch - A hand- or power-driven machine having one or more drums or barrels on which to wind a chain or rope and used on board ship for hoisting or hauling.

Wire rope - Rope made of metal wires twisted into strands and strands twisted into rope. The strands are in most types twisted around a heart or core made of hemp or wire.

Wire rope clips - Mechanical means of securing wire rope together consisting of a U-bolt, roddle (saddle) and nuts.

Working load limit (WLL) - See Safe Working Load.

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